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PC MAGAZINE

THE PENTIUM AND BEYOND

Cyrix and AMD Line Up to Challenge Intel

NETWORK EDITION

Databases PC Labs Tests Nine Options For Everyday Data Management

Network Operating Systems Beyond File And Print Sharing

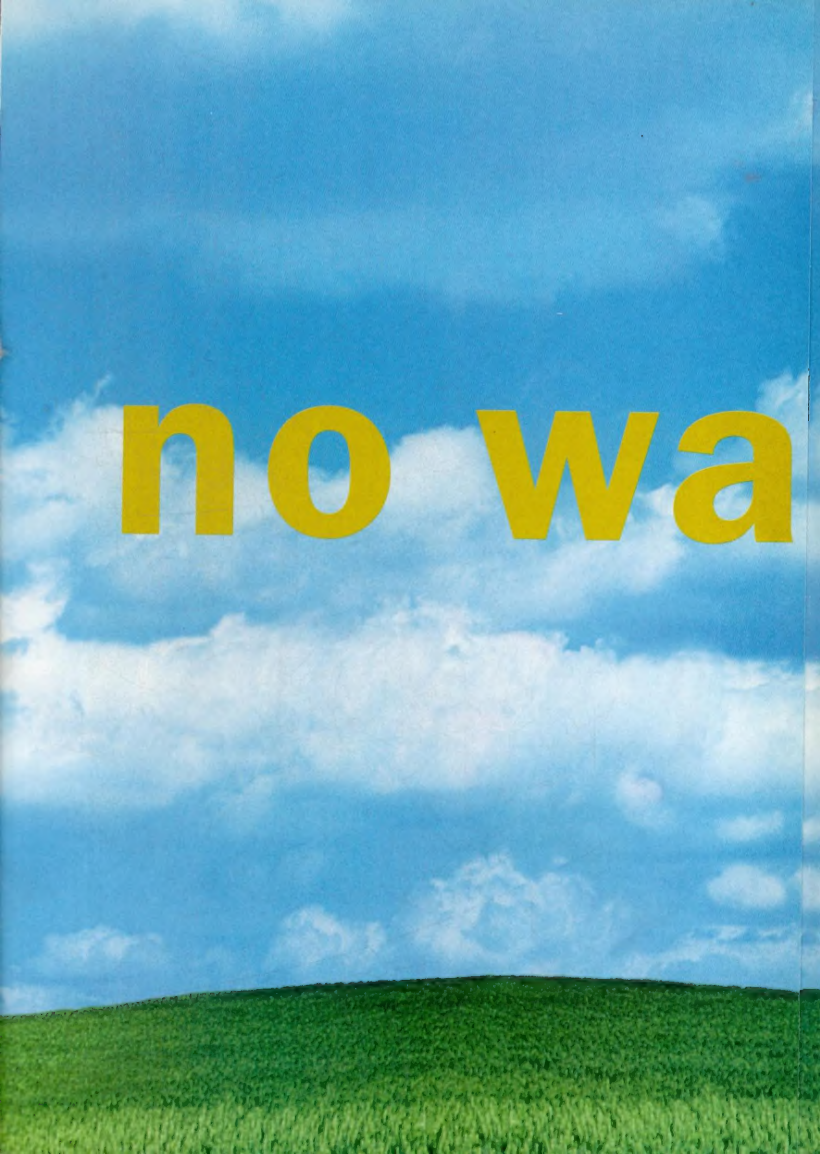
Microsoft Battles Netscape for Control Of the Internet

THE WEB @WAR

Navigator vs. Internet Explorer

FastTrack vs. Internet Information Server

ActiveX vs. Navigator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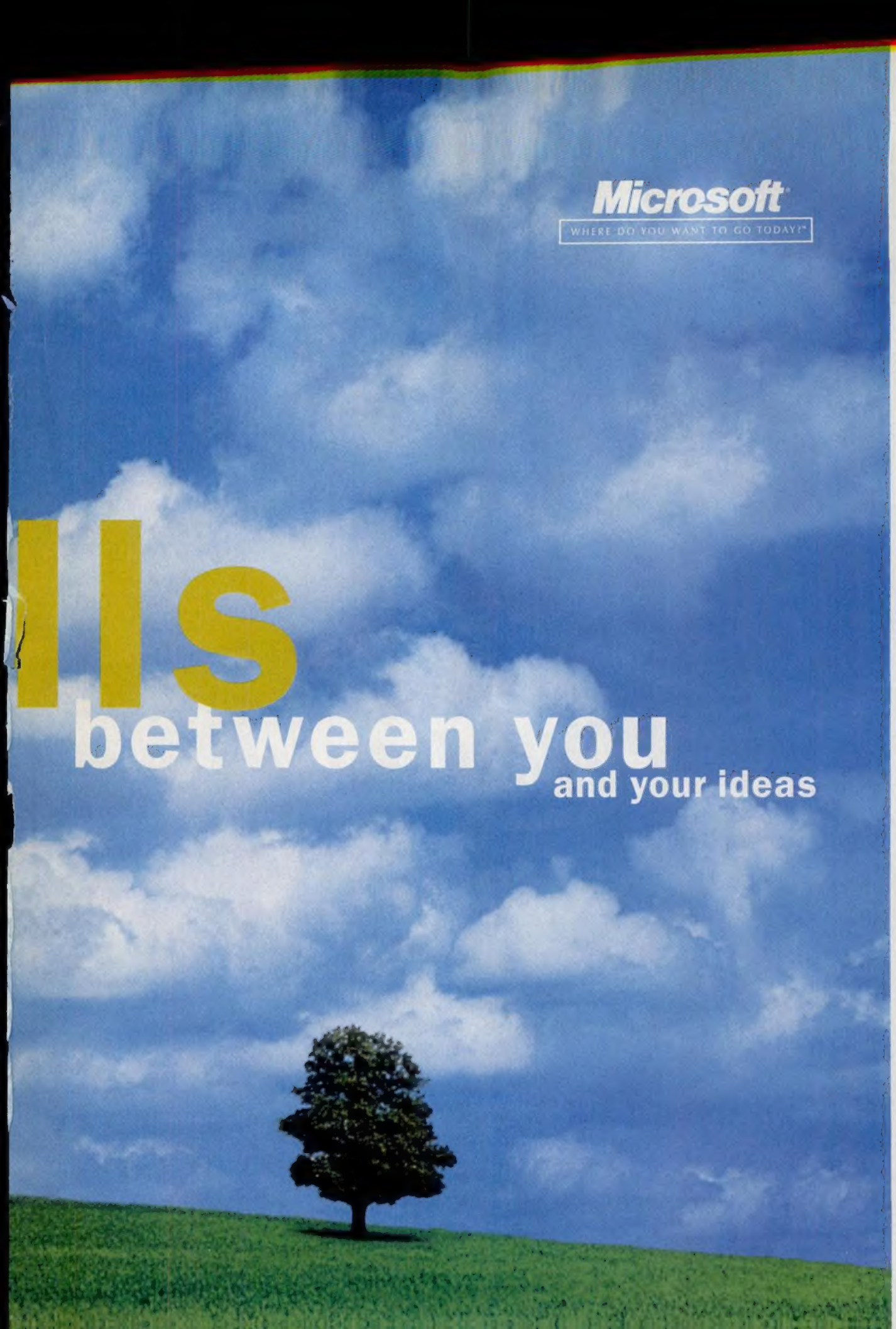
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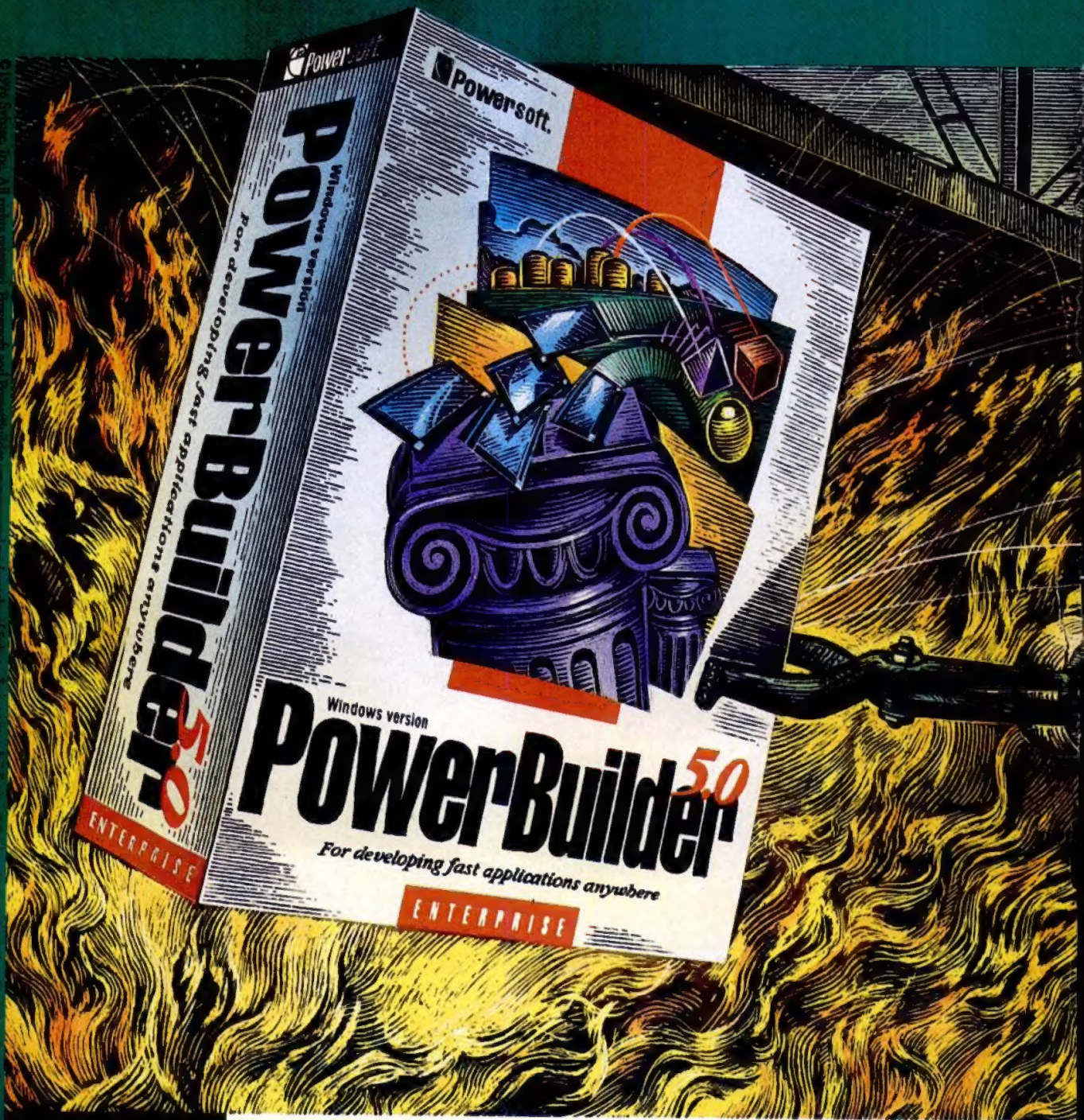

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Inside

In the PC industry, competition is rampant. Still, we've never seen anything quite like the current competition for market dominance on the World Wide Web.

At separate developer conferences, Netscape and Microsoft recently laid out compelling but somewhat contradictory visions for the Web. Netscape is dominant right now, with its Navigator browser holding from 50 to 90 percent of the market, depending on whose numbers you believe. But Microsoft is coming on strong with a strategy to integrate its Internet Explorer browser with its Windows user interface.

ILLUSTRATION BY ANDREW FAULKNER

To report on these changes as quickly as possible, senior editor Brian Nadel mobilized our First Looks team to bring you coverage of the latest products from Netscape and Microsoft. Both companies have recently announced changes in their development strategies and browsers, so in this issue *PC Magazine* technical director Larry Seltzer and senior technical editor John Clyman take a hard look at what these vendors have to offer. Contributing editor Tony Pompili looks at inexpensive new Internet servers from both.

As the market evolves, browser use will be accompanied by the newly emerging class of products known as plug-ins, which were first designed for Netscape Navigator and which Microsoft says will run in its next-generation browser as well. Senior editor Sebastian Rupley and staff editor John Morris look at the latest developments in plug-ins, focusing on how they will affect our interaction with Web sites.

We're also seeing more interactive, more intelligent, and more business-oriented sites on the Internet. To cover this part of Web development, Rupley and executive editor Rick Ayre have been looking at the latest in commerce on the Net.

You'll notice that this special report contains reviews of beta software. To keep up with the ever-changing Internet, we will now review prerelease software that is downloadable.

Our coverage starts on page 39 of this issue. Stay tuned for further developments here in the magazine and at our Web site, *http://www.pcmag.com*, as the war for the Web unfolds.
—*Michael J. Miller*

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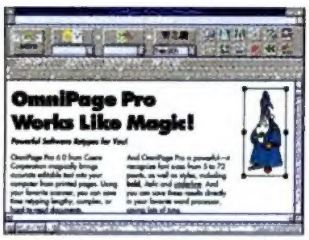

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COVER STORY

A First Looks Special Report

THE WEB AT WAR

The Battle for the Future of the Internet

BY MICHAEL J. MILLER The rapid development of the Web has raised the stakes for companies already there and forced the rest to rethink their strategies. With its Navigator browser, Netscape is king of the Internet hill, but Microsoft is vying for the title. We compare their latest browsers and Web server software, review innovative plug-ins and helper apps, and discuss how this framework stacks up against Java and ActiveX. Finally, we delve into the emerging world of electronic commerce and show you the best places on the Web to spend your money. 39

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- First Virtual

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FEATURES

PCs

Beyond the Pentium

BY MICHAEL SLATER The past 18 months have seen a rapid transition from the 486 to the Pentium, a change that has seemingly cemented Intel's position as the dominant microprocessor supplier. But now Intel's top challengers have released chips to compete. To understand the Pentium-class microprocessors of today and tomorrow, we examine the state of this market; we also look inside both the chips themselves and the companies producing them. And PC Magazine Labs tests four of the first Pentium-level systems based on the new 6x86 processor from Cyrix and IBM to see how its performance stacks up against that of the Pentium and the Pentium Pro.....**100**

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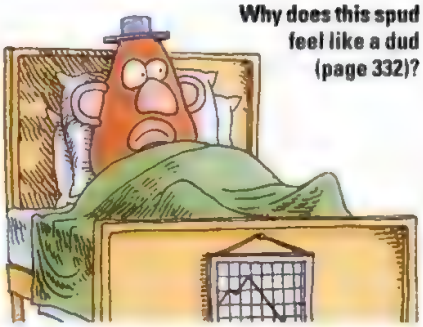

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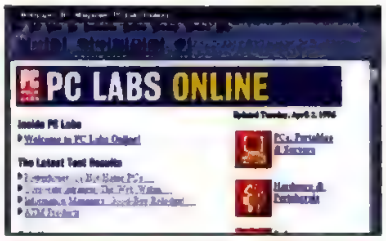

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Dell's featured computer artist is Mark Wagans

No PCs run Windows 95 as well as Dell PCs. Just ask *PC World*, who recently reviewed over 160 desktops and notebooks to judge how well they run Windows 95. And in the end, Dell cleaned up with four Best Buy Awards.

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Fact is, all systems are not the same when it comes to running Windows 95. So check out all the great prices on this page. Tally up those awards. Then give us a call.

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Ultra-High 135MHz Bandwidth	Yes	No	No	No	No	No
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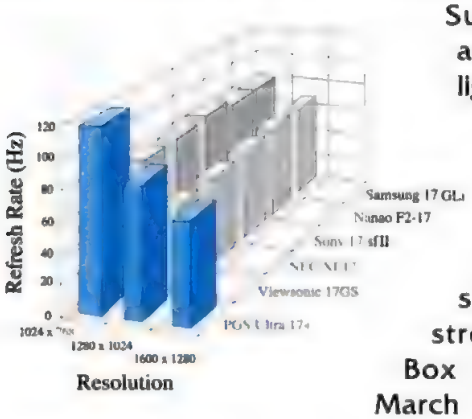

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1996 EDITORS' CHOICE HOMEPC TOP 100 HARDWARE

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Winner - PGS Ultra 15

17" Catagory
Winner - PGS Ultra 17+

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Letters

THE FUTURE OF THE INTERNET

I would not call myself a John C. Dvorak fan, but I have been impressed with his ability to separate a fad from a true revolution. Nowhere is that ability more in evidence than in his column "Internet Insanity" (February 6, 1996), the first article I've seen that puts the Internet into perspective. I love the Internet and all of the great places it can take me, but I have just about reached my tolerance threshold for hype about how it will shape the future of computing. I don't think anything can tarnish the shine of the Internet right now. Dvorak will have to be satisfied with the privilege of saying "I told you so," the consolation prize for being right when no one is listening.

JIM BRIGGS
via PC MagNet

My experience with online services, first Prodigy and then America Online (AOL) with its excruciatingly slow access and interminable adding of new art windows, forces me to disagree with your take on such services. I do, however, agree with Dvorak that the idea of a $500 Web terminal is indeed insanity. The only people for whom it will do any good are those who build and sell servers.

JOE SEIFERT
Huntsville, Alabama

I was irritated with Dvorak's comment that "the socialist and utopian something-for-nothing mentality of the Internet culture can't last long." The Internet has survived for a long time without greedy predatory capitalists trying to squeeze every last dime from the online community. Why is it that as soon as ordinary Americans find a way to exchange information and enjoy an activity, elitists come along and try to step on us and push us back?

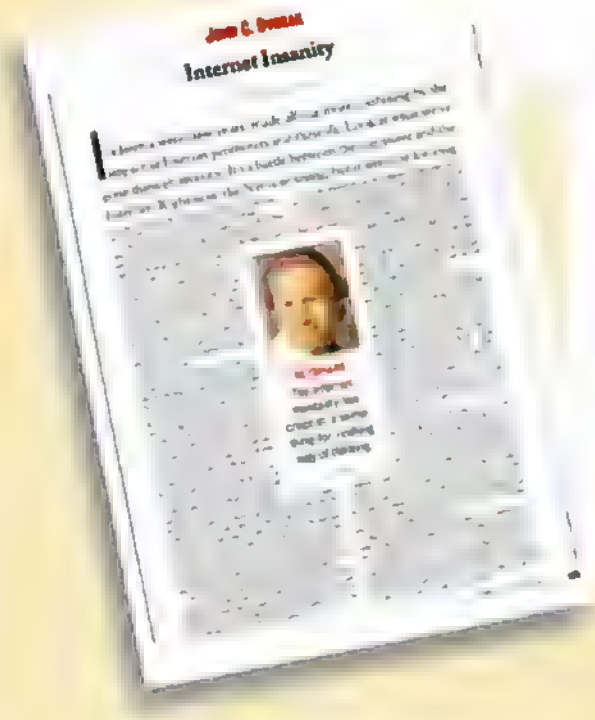
BILL JUSTICE
Shawnee, Kansas

I could not agree more with Dvorak. As an information services manager, I must continually update drivers and install software patches. Online services allow me to find the patch I need quickly and have the hardware up and running as soon as possible. I don't have time to waste on overloaded Web sites or poorly indexed files.

MIKE EARL
via PC MagNet

Dvorak's column on the Internet is only half right. Yes, Internet stocks are overrated, and for now there is not enough revenue for anyone to make gobs of money, other than those companies that provide Internet connection services. No, if Internet stocks start showing signs of their true value, they will not drag down other issues with them. As to his reference concerning a socialist mentality: Schools provide information "free" to the public, commercial sites offer their information in the form of advertising, and organizations such as the U.S. government provide data generated from tax dollars. There is nothing wrong with this. Again, Dvorak has taken a superficial walk into the Internet looking glass.

DAVID N. GLASSMAN
via PC MagNet



Right now, nothing can tarnish the shine of the Internet.

PHOTO OPPORTUNITIES

I was disappointed in your incomplete article "Digital Cameras: The Death of Film" (February 6, 1996). As a professional photographer and publisher of computer-generated, black-and-white in-house publications and newsletters, I have long awaited the happy day when I could escape the drudgery of the darkroom by using a digital camera. While it is no secret that the cameras you describe are as yet incapable of producing color images good enough for publication, perhaps one might produce good black-and-white images, which are still enormously useful especially if they can be manipulated by software. I am still waiting for someone to report on the efficacy of available digital cameras for black-and-white work.

HARRY GEHLERT
Baltimore, Maryland

I believe this article's concluding suggestion that digital photography will, over time, absolutely replace film reflects an overoptimistic view of digital imaging and a lack of appreciation for the complexity of photographic film.

JOHN Z. CROZIER
Moorestown, New Jersey

I enjoyed your article on digital cameras, but I'm curious about video capture. Facing the ability to send video over the Web, digital cameras will become second-class citizens in much the same way that 35-mm cameras have with respect to video cameras. Before I go out and buy a digital camera, I would like to know all my options. For the same money, I can make movies with a camcorder and be ready to start doing videos on the Web.

MIKE RICHLING
Kenmore, Ontario, Canada

WHAT'S IN A NAME?

In the Second Looks review of CommSoft's Roots IV ("Growing Your Family Tree," February 6, 1996), I noticed your comments about the new proper-name dictionary. As a genealogist, I'm doubtful as to the usefulness of such a feature, since names change spelling so frequently. As an example, my great-grandfather's name was Goncherow, his sister Americanized it to Gancher, his brother spelled it Gancherow, other members of the family spelled it Goncherov, and some even went back to the original Russian: Goncherovskaya.

ALAN KOBB
via the Internet

PENTIUM HITS THE ROAD

Thank you for the detailed and informative review of notebooks ("On the Road with the Pentium," January 23, 1996). I will be a much more prepared and shrewd shopper because of *PC Magazine*.

ANDREW R. TIMMS
via PC MagNet

I read your recent article on Pentium notebooks with great interest. Good job. However, you make a big point about notebooks being desktop replacements without saying much about docking stations. I am seriously considering using a notebook as my desktop PC, but I would want a decent docking station.

LARIE TRIPPET
via PC MagNet

This is the first time I've read *PC Magazine*, and it's really amazing. After reading your notebook cover story, I have a better understanding as to which one suits my needs. Thanks for the invaluable advice.

CYNTHIA YEN
via PC MagNet

Your article on laptops was really top-notch—just what I've come to expect from you.

NAYLAND PAGE
Salisbury, Maryland

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Letters

speakers, and printer. I'm now down to the notebook and the printer. Please, someone, integrate a printer in a notebook. It might be a little heavier than the notebook alone, but it would sure make my life easier.

ARTHUR ROSENBERG
Rydal, Pennsylvania

Editor's note: The Canon NoteJet IIIcx combines a Pentium PC, color printer, and scanner in a notebook package, although at a travel weight of over 10 pounds, it's a lot to lug around. For more information, see the First Looks review in our issue of February 20, 1996.

TO CD-R OR NOT TO CD-R

All in all, I found Jim Seymour's column "And a CD-R Drive on Every Desk. . ." (January 23, 1996) to be a sloppy piece of work. Compact disk–recordable drives will be widely useful for general storage and file transfer eventually, but not in 1996. Perhaps not in 1997 or 1998, either. For now they're purely a niche product, although a useful one.

BRANDON BLACKMOOR
via PC MagNet

I share Seymour's enthusiasm for low-cost compact disk–recordable drives. In fact, I went out and bought the first HP 4010 that I could get my hands on. After several weeks of agony, I concluded that the unit was not yet ready for prime time and returned it. Discussions on CompuServe indicate that a number of others have had similar experiences. Inexpensive CD writers may well be the super-product of 1996, but I doubt that the HP unit will be the one.

ROY BUSDIECKER
via PC MagNet

HOW TO CONTACT US

We welcome your comments and suggestions. Please send Letters to the Editor via

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All letters become the property of PC Magazine *and are subject to editing. We regret that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the second page of that column.*

CORRECTIONS AND AMPLIFICATIONS

In the March 12, 1996, article "Presentation Hardware: Tools for the Big Show," the phone number listed for ArcanaTech, makers of the IMP remote pointing device, is incorrect. The correct phone number is 412-441-6611.

The city skyline image (a single frame of a digital .AVI video clip) on page 195 of our presentation software evaluation, "Presentation Graphics: Show Business" (March 12, 1996), should have been credited to the Royalty Free Digital Video Clips collection from Four Palms (703-834-0200).

In the March 26, 1996, First Looks article "HP Color LaserJet 5M: Big, Bold, Beautiful— and a Bargain," the phone number listed for Hewlett-Packard Co. is incorrect. The correct number is 800-527-3753.

DIGITAL TROUBLE ON THE HORIZON

Regarding the Trends article "ISDN Heats Up" (January 23, 1996): I am surprised that after about five years of improvement in Europe, the U.S. has finally found alternatives to analog telephone lines. But sadly, instead of learning from former incompatibilities, the developers have once again introduced are once again different versions in Europe and in the U.S.—56K per second (KBps) versus 64 KBps, respectively—making the future look dim for transatlantic ISDN links.

ALBERT BANK
via PC MagNet

THE INS AND OUTS OF PC FINANCE

I was astonished that the review of personal-finance software, "Personal Finance: Banking on Your PC" (January 23, 1996), did not include InCharge. For nearly a year I have been an enthusiastic user of InCharge. I find it far superior in organization and user-friendliness to Managing Your Money and Simply Money.

RON WYLLYS
via PC MagNet

Thank you for the comprehensive personal-finance coverage. An additional advantage of online banking links to financial institutions such as Chemical Bank and Citibank is the ability to download banking transactions directly into finance software such as Quicken, particularly since one of the most daunting aspects of using a personal finance package is the data entry for transactions such as ATM activity, funds transfer, interest earned, and manual checks issued.

RUTH MAZUREK
via PC MagNet

As an online banking customer with Citibank for a full decade, I noted with interest your sidebar on Bank-Ware. However, you neglected to inform your readers about how the bank or service handles problems when they occur. Citibank's customer service department has been exemplary in handling mispostings or any other problems that can occur even in the non-online environment. By contrast, users of other online services (mostly non–bank-managed) have advised me that small problems can often mushroom because of the service's inability of the service to provide timely follow-up.

JONATHAN SPIRA
via the Internet

A WINDOW ON WINDOWS 95

In Jake Kirchner's Pipeline column "Living with Windows 95" (January 23, 1996), he states, "I haven't come across anyone who claims the operating system plain doesn't work or is buggy in any significant way." Frankly, I am sick and tired of hearing how wonderful Windows 95 is when in fact it is badly designed and full of faults.

ARNO ARRACK
Dix Hills, New York

Kirchner and I sure live in different worlds. It took me three months to install Windows 95 on my PC, and that was only after I removed my Bernoulli Box card, my network interface card, and my Mountain tape card. Microsoft's technical-support people were of no help whatsoever during this period. They promised to return phone calls "the next day" and failed to do so for six weeks. So I solved the problems myself. The result? A machine that boots Windows 95 but is, for all practical purposes, useless. Most of my hardware is in boxes, and without any practical backup solution, I can't use the machine for anything important.

JON STRAND
via PC MagNet

I browse the newsgroups and read posting after posting detailing problems with installing Windows 95, with hardware conflicts, with system lockups. All these people are looking for answers from fellow users rather than from Microsoft. Why? The delays and expense of going through Microsoft are beyond many people. My initial experience with Windows 95 was so frustrating that I nearly returned it, although I am now finally happy with it. However, I would be much more impressed if Microsoft would publicly admit some of these problems.

TERRY SMITH
via the Internet

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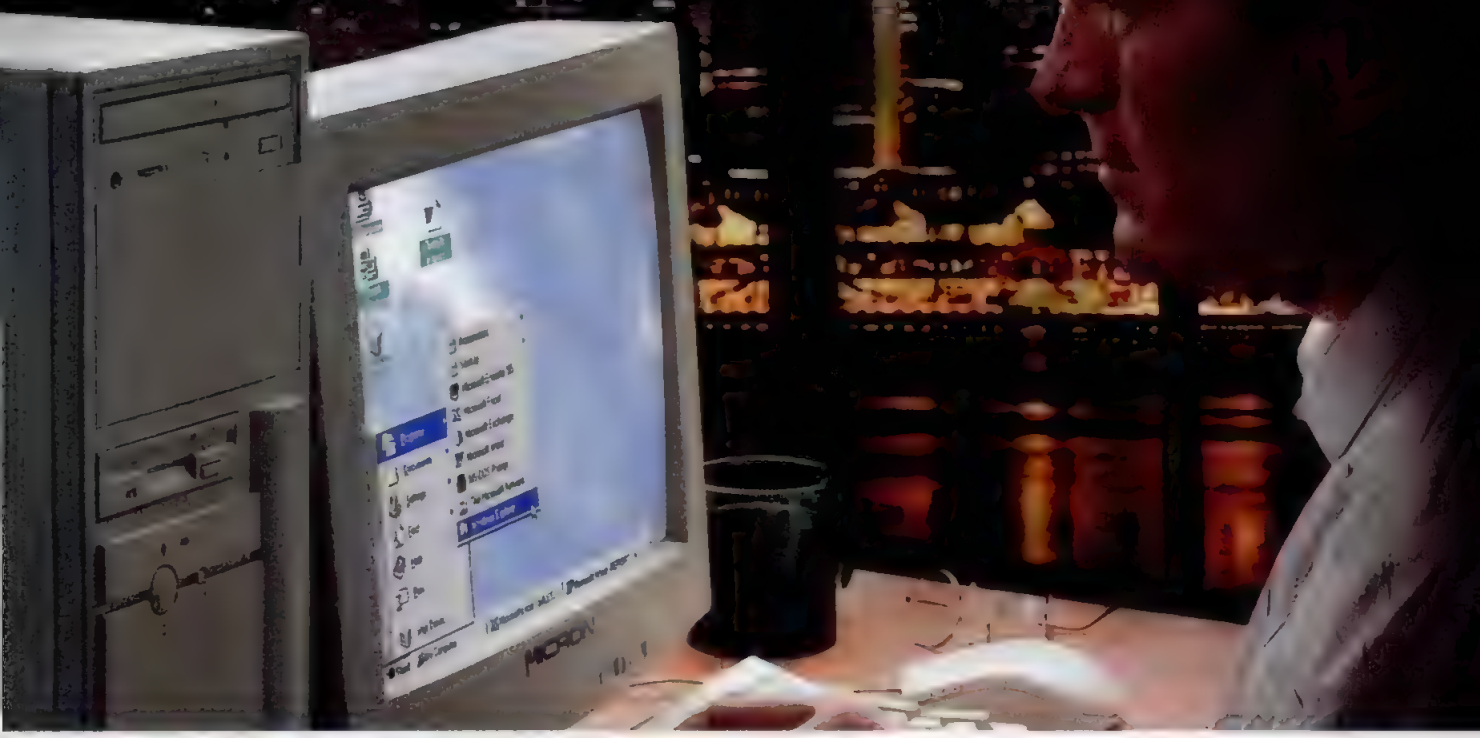

July 1994

Millennia TransPort

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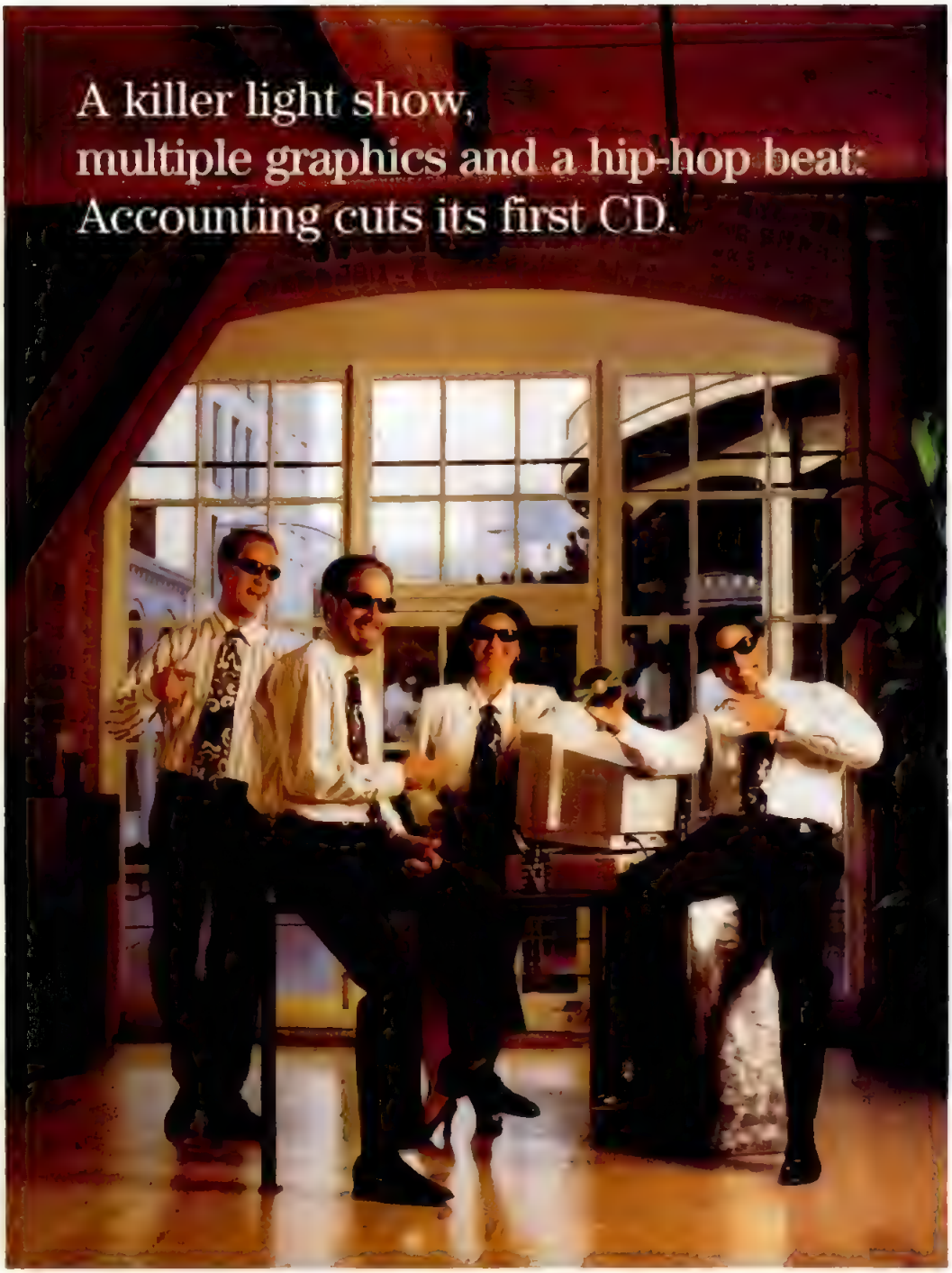

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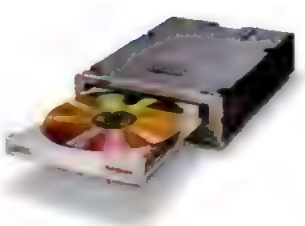

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MICHAEL J. MILLER

Remember Groupware?

Not too long ago, *groupware* was the hot buzzword. Everyone wanted to talk about the advantages of people working together in teams, like it was some big revelation. But fashions change, and as it so happens, groupware as a term never really caught on. But look at what's happened to the way most of us use computers. With the growth of networking in general, and the Internet in particular, everyone is communicating with one another. We all want to work together and better manage the way we communicate. No one thinks in terms of groupware anymore; now we say we want messaging and collaboration. But the basic concept is the same.

Microsoft has recently gotten a lot of publicity in this area with the release (*finally*) of Exchange, its messaging server for Windows NT. Exchange isn't everything Microsoft promised it would be when it was announced a few years ago, but it is a client/server messaging solution. And Microsoft backers talk about how you will be able to use it to create a messaging platform linked to the Internet.

Meanwhile, in client/server land, the strongest competitor seems to be Lotus Notes. Netizens like to talk about how Notes, with its unwieldy infrastructure and proprietary schemes, is passé. Still, since IBM acquired Notes, it has gotten stronger with growing sales, the shipping of Release 4, and more aggressive pricing. And Lotus hasn't ignored the Internet. If anything, the company is embracing it in Release 4 by integrating the InterNotes server for turning Notes databases into standard Web pages and by adding browser features to the Notes client. And Notes still has several features that other products don't, such as replication.

Almost overlooked in the Notes versus Exchange competition, though, is the fact that a number of other significant players are out there. Novell's Groupwise, for instance, is the Rodney Dangerfield of messaging systems: It doesn't get much respect, or much attention, but thanks to features such as advanced integration of a variety of media, it's selling very well. Novell is also at work on a new client/server version called Groupwise XTD.

Still, the real competition may well come from Internet-based products. Several companies, led by Netscape, are backing Internet standards such as Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP), and the Network News Transport Protocol (NNTP). Although we've yet to see these standards implemented successfully for messaging in large companies, at least SMTP and POP are open standards, and widespread adoption could eliminate troublesome gateways.

PHOTOGRAPH BY ANDY FREEBERG

FANTASYWARE

There's more than a little gap between the promise and what companies are delivering.

Consider some recent announcements from some unexpected sources. Digital Equipment Corp. is setting up a whole new division devoted to Internet tools, with a family of products carrying the name of its Alta Vista search engine for the Internet. Quarterdeck recently acquired DataStorm and its Procomm Plus, with integrated e-mail, fax, and browser features; as well as FutureLabs and its TalkShow technology for document sharing. Combine this with Quarterdeck's WebTalk program for transmitting voice over the Internet and its Prospero software for IRC chat and other extensions, and Quarterdeck has the makings of a real collaboration suite. But don't forget about Netscape, which is counting on the acquisition of Collabra and its Share technology to transform its immensely popular Navigator from a browser into a full-fledged client with integrated e-mail and discussion groups.

It all sounds pretty good. Yet in all these cases, there's more than a little gap between the promise and what these companies are actually delivering today. Notes, the closest of all these products to delivering on these promises, still relies on a proprietary mail scheme that requires gateways, and the program still isn't a complete Internet server. The rest are even further away. Exchange is untested and not well integrated with Microsoft's Web server software. Groupwise is under construction, and Netscape isn't shipping Collabra-developed products yet. Digital and Quarterdeck have some interesting products, but they have yet to be incorporated in an integrated scheme.

Where does this leave us? As usual, somewhere in limbo. A few years ago, we were all waiting for the magic groupware solution; now we are waiting for the ideal collaboration solution that also works with our messaging systems and, of course, comes from a single vendor. For now, we have to accept that the ideal solution remains just out of reach. □

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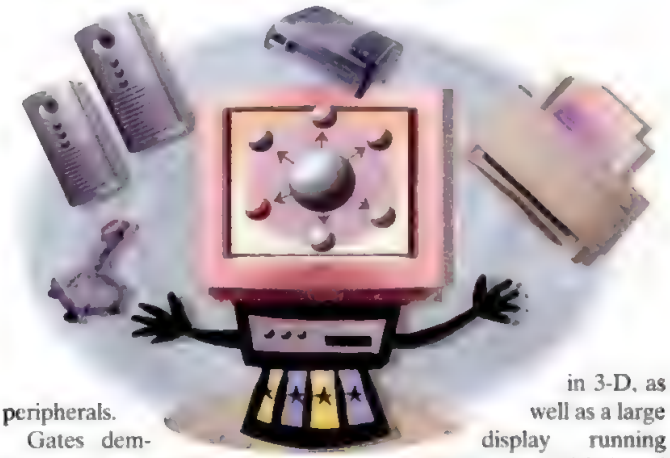
Trends

TRENDS & TECHNOLOGIES SHAPING THE PERSONAL COMPUTER MARKET

The Simple PC

New hardware heads for the living room.



More than 3,000 hardware engineers gathered for the annual Windows Hardware Engineering Conference in March to learn details and witness demonstrations of a radical new kind of PC based on Microsoft's Simply Interactive PC (SIPC) initiative. Dubbed "OnNow PCs," the new machines will be designed to turn on instantly and to operate multiple peripherals transparently.

Compaq, Hewlett-Packard, Intel, Phoenix, and Toshiba are all developing products designed to advance the SIPC initiative. And many new technologies, especially simple ways to connect peripherals, appear headed for marquee-level status in conjunction with the SIPC initiative.

According to Microsoft's Bill Gates, a recent MIT poll revealed that 8 percent of the population designated PCs as "an invention that they couldn't live without," while over 50 percent of respondents classified cars and light bulbs as such. Gates described his desire to see PCs move to an over-50-percent response level in future versions of such a poll. "Hard work lies ahead in the hardware community to make the PC more like an appliance—turned on immediately, and hassle-free," said Gates.

The evolutionary advancement of the PC platform, which initially centered on applications software, will increasingly center on information consumption—Web browsing, movie watching, and so on. Figuring prominently in Gates's vision of SIPC devices are large screens, multiple peripherals, serial buses, instant-on features, and advanced multimedia capabilities built on Microsoft's ActiveX and DirectX initiatives.

SIPC machines will also take on radical, new "sealed-case designs." Hewlett-Packard's prototype resembles a VCR, but is, in fact, a PC with Universal Serial Bus connections and IEEE 1394 connections, in both front and back, for daisy-chaining multiple peripherals.

Gates demonstrated the device by playing sound effects, which he sent around the room to various speakers using a joystick. He also showed a living-room-ready, 31-inch display running high-resolution, virtual-reality games in 3-D, as well as a large display running Digital Video Disk–based movies, with the sound bouncing around the room to various speakers. DVD and Microsoft's Active Movie API have starring roles in Gates's vision of SIPC as a movie platform.—*Sebastian Rupley*

Cyber-Cellular Phones

Wireless e-mail, Web access.

Be-all, end-all wireless-communications technology always seems a couple of years away. Phone carriers, manufacturers of wireless gadgets, and communications giants are constantly upgrading infrastructures and debating one standard's promise over another's ubiquity—all in an effort to attract millions of potential customers for wireless services. Now, several companies are turning the spotlight to a proven crowd pleaser—the Internet—with cyber-cell phones.

WIRELESS INTERNET: *Mitsubishi's MobileAccess is a cellular phone, pager, modem, and fax.*

You probably won't surf the Web with these new hybrid phones, but you will be able to send and retrieve e-mail—by far the most popular Internet activity. Motorola is one of the first companies to capitalize on the idea. Its new Wireless Internet Service—based on Code Division Multiple Access, one of the several digital standards vying for dominance in the U.S.—lets cellular phones retrieve e-mail, weather forecasts, stock prices, and sports scores via the Internet.

Mitsubishi's MobileAccess phone uses the analog Advanced Mobile Phone Service system and Cellular Digital Packet Data technology for paging, e-mail, fax, and voice services. And since MobileAccess phones run TCP/IP, the networking protocol that runs the Internet, they can access both the Internet and private intranets.

"Though high prices may delay American consumers' entry into this market, these phones will provide another way for mobile business users to communicate quickly via the Internet," says Dataquest analyst Clint McClellen.

Other companies, such as L.M. Ericsson and Nokia, are developing hybrid phones for the European market, where a digital standard, Global System for Mobile Communications (GSM), is in place. Nokia's upcoming cyberphone has a handset with a keyboard and screen, a personal information manager, wireless fax capabilities, Web access, and wireless-modem support for connection to notebooks—all for about $2,000.—*Angela Hickman*

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Object Technology on the Web

Small players join powerhouses in development push.

Object-oriented database applications are positioned to be the next wave in Web content. Applications based on object technology are taking shape for both intranet and mainstream Web use. These applications have advantages over other tools, such as speedy development and facility in handling Web-based audio and video.

Object databases shine at piecing together distributed applications from components that may reside on a series of servers. Object applications are ideal, for example, for on-the-fly preparation of personalized Web pages in response to queries.

At Microsoft's recent developers' conference, Steve Jobs demonstrated such an application, built with NeXT's WebObjects software for Chrysler. The application allowed Jobs to select a line of Chrysler's cars, enter a target price, then receive a custom, graphical set of Web pages.

Bill Gates gave a demonstration of a Web commerce application that Microsoft has developed with Wal-Mart. The application allowed an online shopper to send criteria to a store, then receive a personalized catalog of Web pages. Both demos made use of Microsoft's ActiveX object controls. "Building custom Web pages on the fly in response to database queries looks very different from anything you see on the Web now," said Jobs.

ONLINE SHOWROOM: *Chrysler's new Web page has object-oriented database smarts.*

Microsoft may command an advantage because of its Access database technology and because of Windows 95 and NT 4.0's support for Distributed COM (Component Object Model). COM, the core object model in OLE, helps Microsoft's OSs run distributed objects as a unified local application.

Sun's Java will also benefit from the object push. Microsoft has struck a licensing agreement with Sun that enables Microsoft to use object technologies in conjunction with Java. Object database players are already working on Java interfaces for their object database systems. Both Object Design and Versant Object Technology have plans to release Java interfaces for their object database systems. Versant's interface will ship soon in a version for Windows NT.—*Sebastian Rupley*

Intel Pumps Up Multimedia

MMX enables realistic games and software modems.

In an effort to equip future PCs with more multimedia functionality at better prices, Intel has announced the most significant extension to the *x*86 processor architecture since the 386. Dubbed MMX—which Intel insists *doesn't* stand for Multimedia Extensions—the technology includes new instructions designed to speed processing of multimedia-related functions. MMX will first be implemented in Intel's P55C processor, an enhanced version of the Pentium due to ship late this year, and will migrate into the Pentium Pro and all future Intel processors.

MMX extends the processor without altering its behavior when running existing code. Thus, the chips will be compatible with applications in use today. Also, since MMX requires no alterations to system designs, hardware, or operating systems, its adoption by software developers should be rapid.

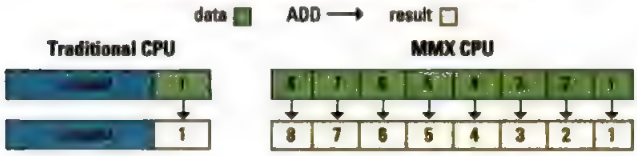
You'll benefit from MMX in two ways. First, the technology will help accelerate multimedia applications such as games. Here, the CPU's ability to process certain data far more rapidly will translate into higher-resolution, more-colorful, more-realistic programs. Second, MMX will help reduce the cost of capabilities such as modems and wavetable audio. In today's PCs, it's impractical to implement these features using only the CPU. In an MMX-equipped PC, a modem could be implemented in software with a minimum of hardware.

If MMX sounds like the native signal processor (NSP) initiative that Intel promoted about a year ago, it's no coincidence: MMX is a mechanism for achieving much of what NSP proposed. But now Intel recognizes that the power of even today's Pentiums is not sufficient to realize those goals.

For word processing, spreadsheet analysis, and the like, MMX will give few performance benefits. But PC performance needs are increasingly being driven by demands for realistic multimedia, and in that realm, MMX offers immense promise.—*John Clyman*

How MMX Works

An MMX-enabled processor can perform an arithmetic operation on eight bytes of data in the same amount of time a traditional processor needs to process just one byte. In a traditional CPU, each byte of data is stored in a 32-bit, general-purpose register. The ADD operation takes one clock cycle to compute the result. In an MMX CPU, eight bytes of data are "packed" into a single 64-bit MMX register. The ADD operation takes one clock cycle to compute all eight results.



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PC MAGNET. From this online service of ZD Net available through CompuServe (GO PCMAGNET), you can download *PC Magazine* utilities (GO TIPS) and join freewheeling discussions about new products in *PC Magazine*'s Editorial forum (GO EDITOR). **Features Plus:** From May 13 to 17, discuss home printers with *PC Magazine* contributing editor Bruce Brown and representatives from Canon, Epson, Hewlett-Packard, and Lexmark.—*Tin Albano*

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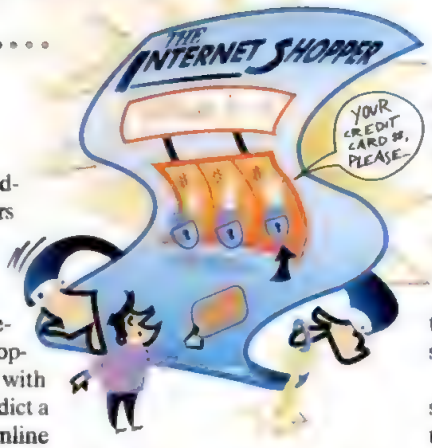
Online Software Stores

Developers experiment with virtual shelf space.



The Seattle-based software distributor Online Interactive wants to become your local computer store. A new licensing agreement with Microsoft lets Online Interactive sell—and deliver—most of Microsoft's software programs, including Windows 95 upgrades, over the Internet. And it's all done without sending credit-card information over the Internet.

Online Interactive's model is simple: Visit the AtOnce sight, pick your software, and it's downloaded to you in encrypted format. You then enter your credit card information, which is verified over a private network via a toll-free number. After authorization, a key that unlocks the software is sent to your PC.

Online Interactive, which started distributing over America Online, opened a new branch last August on the Microsoft Network. Its Web site carries dozens of products, all priced slightly below the lowest street prices. Product selection should grow dramatically over the next several months, said Online Interactive president Tim Choate.

"Since virtual shelf space is much cheaper than a storefront, Online can represent thousands of products," said Choate. "We can carry Microsoft Word and hundreds of related add-on products, while traditional resellers can barely find shelf space for mainstream software."

It's probably too early to burn your Egghead Cue-Card, however. Large developers like Microsoft, along with most industry analysts, predict a relatively small role for online software distribution. Though committed to the emerging online channel—along with other big players such as Oracle—Microsoft is not abandoning more traditional retail channels.

The market-research firm IDC also predicts that direct and reseller channels will remain dominant for the foreseeable future. Senior vice president John Gantz explained, "We looked at the total market for packaged software, analyzed for software that could be delivered over the Net, and still think that only 5 to 7 percent will be sold online by the year 2000."

"Even though it's a relatively small percentage," Gantz continued, "it will be a very significant channel for users seeking applets to complement their primary programs."—*Jan Ozer*

Top CD-ROMs

1. **TurboTax Deluxe** Intuit
2. **Microsoft Windows 95 Upgrade** Microsoft
3. **Quicken Deluxe** Intuit
4. **Print House for Windows 95** Corel
5. **Myst** Broderbund Software
6. **Wing Commander IV** Origin Systems
7. **Warcraft II: Tides of Darkness** Blizzard Entertainment
8. **Microsoft Encarta '96** Microsoft
9. **The Ultimate Doom: Thy Flesh Consumed** GT Interactive
10. **Print Shop Deluxe CD Ensemble** Broderbund Software

Source: PC Data. Data for February, 1996. Additional lists at *http://www.zdnet.com/pcmag/topten/topten.html*.

ILLUSTRATION BY BARBARA FRIEDMAN

Programming Crowd Control

Math whiz studies crowd dynamics at Wembley Stadium.

The ability to do repetitive tasks at lightning speeds makes computers seem omnipotent: leave them crunching away at a problem at the end of the day and they'll come up with a solution overnight. Research scientists, however, have discovered some problems that are simply impossible to solve with traditional techniques, no matter how big or fast the computer.

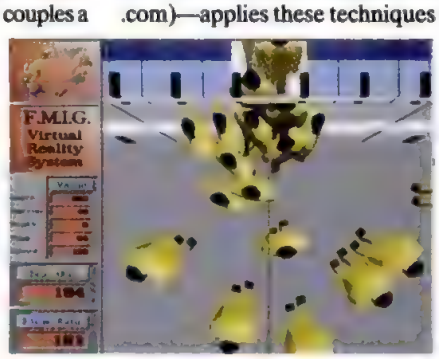
Such a problem occurs when the number of elements to analyze is very large, because a program must consider every possible situation. Modeling the movements of crowds at a stadium, for example, poses two difficulties: You must provide to the computer knowledge of every contingency, and if the number of possibilities is large, you may have to wait literally forever for the solution.

G. Keith Still, a Scottish mathematician who studies crowd dynamics, has invented some powerful programming techniques to deal with this problem. Still's approach, which he calls "entity-oriented programming," couples a virtual-reality landscape based on dynamic fractal calculations with self-aware entities that can react to the landscape and to one another. He then encodes the rules that govern how systems operate, rather than the behavior of each individual element.

Still has developed a library of routines, called Legion, to implement this technique. "We program in simple rules and let the system replicate, evolve, and grow. What happens is awesome when you first see it—you get emergent behavior," says Still.

With entity-oriented programming, the problem shifts from determining all possibilities to determining the rules that give rise to complex behavior. "For example, a simple set of rules can model a flock of birds," explains Still. "To create birds, we need three rules: match speeds with the nearest neighbor, maintain a minimum distance from the nearest neighbor, and try very hard to get to the center of the flock. When we do this, the birds behave like a flock of live birds—swooping, dividing around solid objects, reforming again—a whole range of complex behavior from a few simple rules."

Still's own company, FMIG—Fast-Moving Interactive Graphics (100414.3265@compuserve.com)—applies these techniques to crowd management, entrance and exit design for buildings, and barrier design for minimizing bottlenecks for London's Wembley Stadium and other clients.



HEY, MOVE IT: *Math minimizes bottlenecks.*

Still has also had success using Legion to model financial markets, and he's working on encryption and compression applications. In fact, the technique can be applied to any complex interactive system, such as biological cells, currency markets, or ecosystems.—*Sheryl Canter*

PIPELINE

By Jake Kirchner

Good Government Doesn't Come Cheap

Contrary to the popular wisdom of the PC industry today, politicians are not stupid. I spent 15 years in Washington covering high-tech issues, both on Capitol Hill and throughout the federal bureaucracy. In that time, I saw a lot of decisions that adversely affected the creators and users of computer and telecommunications technologies, but I never found the legislators and regulators making those decisions to be ignorant. Attaining national political power is difficult; stupid people need not apply.

In the "old days"—when computing primarily meant IBM and a few other large firms—the major vendors were intensely involved at every level of the federal government. Through associations, lobbies, and the personal activities of top company executives, the industry participated constantly—and effectively—in congressional hearings, regulatory proceedings, and lawsuits related to the technology business.

To a great extent, now that the computing industry is led by companies like Microsoft, Novell, Netscape Communications, Sun Microsystems, and America Online, we've lost that involvement in government. We go to Washington only when some agency does "something stupid" and tries to break up Microsoft, or (depending on your outlook) refuses to break up Microsoft, or moves too quickly or too slowly into telecommunications-industry deregulation. At that point, any outcry is way too late for intervention.

For the PC industry, the supposed cure for bumbling bureaucrats has been to elect politicians who "get it" when it comes to the benefits of technology. You'll remember that the leaders of Silicon Valley were big supporters of the Clinton-Gore election campaign four years ago. You're probably aware that Republican kingpin Newt Gingrich is a big fan of new media and the convergence of computing and communications technologies.

For the PC industry, the supposed cure for bumbling bureaucrats is electing politicians who "get it."

So, how do we explain corporate depreciation and capital investment regulations that hobble the growth of PC hardware and software companies? How do we explain the Communications Decency Act and the current administration's willingness to support it?

These days, every industry conference I attend occasions discussion about the perceived dangers of our ignorant government leaders. At Esther Dyson's annual PC Forum recently, Netscape president and CEO Jim Barksdale declared, "It's dangerous if people know so little [about technology] but are regulating it."

Dyson, for her part, responded that "this rhetoric is doing more harm than good. Some people want control, some people want to protect children, but we tend to term all of them as right-wing nuts." She's right. The question is, what do we do about it?

Remember that many people in this country (and a few in Washington, D.C., no doubt) regard Bill Gates, Jim Barksdale, and the like as elitist and unconcerned about the possible adverse effects of technology on employment, international trade, and the moral development of our children. Calling those people ignorant isn't going to help.

The basic tenet of our country's republic is that we are the government. But we can't be the government if our only contribution is dashing into a voting booth every two years.

The Internet Shakeout

Anarchy, utopia, or something in-between?

At this stage in the Internet's evolution as a form of communication and commerce, we're merely throwing spaghetti against the wall to see what'll stick. Bob Gill, an Internet analyst with the market-research firm Gartner Group, is in the business of predicting just who ends up sticking around—and who ends up on the floor.

It's not as rosy a picture as some may think. As the transport mechanism provided by Internet service providers is driven down to commodity pricing, content owners will likely have the real power on the Internet. Gill predicts that 80 percent of the thousand or so ISPs in business today will eventually drop out.

The thousands of "content wannabes," as Gill calls them, will become overshadowed by big media companies wielding brand recognition. "The leading entertainment aggregators will likely leverage their brand recognition into powerful positions on the Internet," explains Gill. The small content developers won't disappear completely, but they will sell their products to big media companies.

Gill has constructed three possible scenarios for the Internet's next step. In the most unlikely, the Internet leads to utopian benefits: bandwidth is plentiful; applications, free and instant. International regulations are relaxed, and Internet literacy becomes the norm.

In another unlikely scenario, anarchy causes a strong backlash, and the Internet becomes a no-man's-land in which information attack becomes sport. The overwhelming number of applets and plug-ins makes the Internet dysfunctional. Electronic borders are closed as intellectual wealth drains away from developed nations.

ILLUSTRATION BY LISA MANNING

In the most likely scenario, cycles of explosive growth are followed by corrections. Bandwidth is affordable, but the gateways between corporate intranets and the global Internet are heavily guarded.

Gill predicts that Internet technology will "be used increasingly for intranets and interenterprise communications linking employees, customers, suppliers, and business partners."—*Carol Levin*

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

The Web at War

The Battle for the Future of the Internet

By Michael J. Miller

Every time you connect to the World Wide Web, it seems that you can find another site that goes far beyond the Web's original concept of being a way to present static pages viewed through a browser. Today, the most compelling Internet destinations offer animation, sound, and video, customized content, or ways for Web consumers to buy products in cyberspace. The net result is that the era of the interactive Web is dawning.

Not surprisingly, Netscape Communications Corp., the maker of Navigator—the leader with 80 to 90 percent market share for browsers—wants to continue to set the pace for the emerging interactive Web. Its HTML extensions, notably those for presenting tables and frames, have become standards for Web designers. Netscape's Navigator plug-in architecture is the de facto standard for adding multimedia pizzazz to a Web site, and its support for Sun Microsystems' Java is the most popular way of embedding interactive elements into Web pages.

Nothing on the Web stands still. Netscape is promoting three ways of adding even more excitement in the future: Live Objects for integrating multimedia, server-based Java, and NSAPI, its server-applications interface.

At the same time, Microsoft, the dominant supplier of operating systems, is playing catch-up and wants to control the direction of Web development. In its next-generation Web browser, Internet Explorer 3.0, Microsoft supports some Netscape standards, such as the HTML extensions, Navigator plug-ins, and Java. But Microsoft is adding its own take on the future of the Web by proposing new standards. The most notable are ActiveX, which adapts Visual Basic–style objects (.OCXs) for the Web, and ISAPI, its Internet Server API.

Perhaps most important, Microsoft plans to integrate Internet Explorer into Windows 95. This will not only streamline setup but will let you look at your hard disk and the Web as a single unit.

Such an assault is nothing short of a direct challenge to Netscape. But Netscape continues to have the advantage, as most Web sites are designed for its browser. Still, the Web is evolving rapidly, and the rate at which innovations are adopted by Web-site developers may well determine which "standards" truly become standard and which are forgotten.

In the pages that follow, we'll take a close look at each company's battle plans, armor, and chances of success on this battlefield. We'll start by examining the strategies and the latest browsers from Netscape and Microsoft, as well as their newest servers, Netscape FastTrack Server and Microsoft Internet Information Server Version 1.0.

Then we'll look at the newest Navigator plug-ins and how they compare with ActiveX and Java. Finally, we'll examine two ways of doing business on the Web: sites that support credit card transactions and those that use one of the emerging digital-cash schemes. A series of book reviews, some of which show you how to use digital cash on your Web site, follows.

Regardless of whether this is a protracted battle or one with a quick resolution, one thing is certain: The Web will not stay static.

SPECIAL REPORT

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ILLUSTRATION BY ANDREW FAULKNER

WEB BROWSERS

The Browser Battle Between Microsoft and Netscape

By John Clyman and Larry Seltzer

The battle lines have been drawn for a clash over who will shape the future of the World Wide Web. On one side stands Netscape, creator of the enormously popular Navigator browser, with an impressive array of Internet armor and artillery. On the other side is Microsoft, which is trying to use its leadership role in desktop operating systems to make an online strike with Internet Explorer. The victor will likely determine not only which Web browser you'll use in the future but also what the Web will look like.

Neither Microsoft Internet Explorer 3.0 (available at *http://www.microsoft.com)* nor the Atlas version of Netscape Navigator (available at *ftp.netscape.com)* we looked at for this roundup were feature-complete. Each will be finished and officially released in the coming months. And each developmental program offers insight into its company's intended strategy and direction for providing Web interactivity.

Netscape Navigator Gold provides a near-WYSIWYG view of what your emerging Web page will look like.

At first glance, Internet Explorer 3.0 (IE 3.0) is the more impressive program because it integrates so tightly with Windows 95. Microsoft's ultimate goal is to replace the Windows 95 Explorer entirely, using IE 3.0 as an interface for the Internet, a corporate intranet, and the contents of your local disk. During evaluation, we had trouble moving among views, but on the whole, we were impressed with this concept.

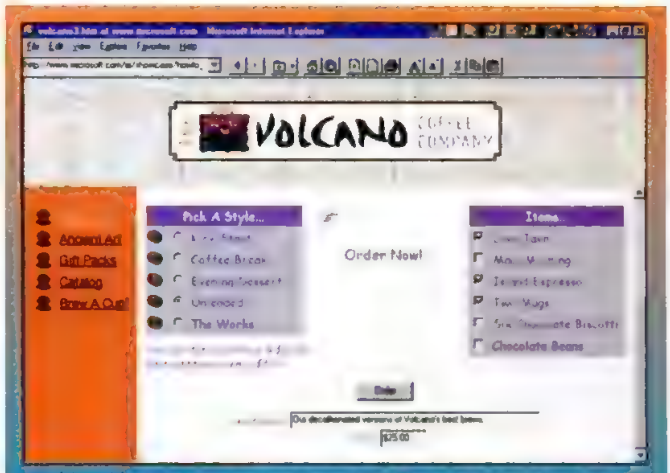
CATCHING UP

The IE 3.0 browser catches up to Navigator by incorporating its HTML extension for frames, which allows Web developers to segment the browser canvas into multiple independent panes. To that foundation, IE 3.0 introduces its own HTML extensions, including a FACE parameter for the existing FONT tag, which lets designers more accurately control typography by specifying a prioritized list of alternative fonts.

As a result, IE 3.0 currently draws from a broader set of extensions than Atlas can. Such capabilities are a prelude to Microsoft's use of CSS (Cascading Style Sheets), a proposed standard that lets both author and reader define preferences for fonts, spacing, and layout. At press time, Atlas didn't support these extensions or earlier Microsoft-inspired ones, such as background sounds; marquees, which can enable scrolling text; and watermarks.

Navigator was ahead of IE 3.0 with support for Sun's Java, an object-oriented, platform-independent language. Java has enabled early Web interactive content, from stock tickers to database front ends.

Microsoft's answer is ActiveX technology, which produces essentially Internet-enabled OLE custom controls (.OCXs) that provide in-place, interactive viewing and editing. ActiveX controls are not incompatible with Java; in fact, Microsoft plans to use wrappers to make Java applets behave like ActiveX objects.



This Microsoft demo page shows IE 3.0's use of borderless frames and the company's VBScript.

Two keys to infusing interactivity into Web pages are moving beyond server CGI scripts and developing client-side scripting languages; the latter lets developers provide interactivity within the HTML source code. This can free the developer from the complexities and performance problems of using server-based CGI scripts, which are memory-intensive and can't communicate directly with the server.

For example, forms processing traditionally required that the user fill in a series of fields and send a request to the server for processing against a database. Scripting could let the designer notify the user in response to inappropriate entries or provide dynamic information, such as which items on an order form are in stock.

Navigator provides direct support for JavaScript, a Java-based language that enables these kinds of capabilities and more. Though IE 3.0 has added JavaScript support, Microsoft's real thrust is in using its Visual Basic–derived VBScript language.

In addition, both Microsoft's Internet Server API (ISAPI) and Netscape's NSAPI address the limitations of CGI scripts. These APIs create ways for a server-based application to run in the context of the server, which can streamline operations, lower system overhead, and allow easier and more detailed communication with the server. Both achieve the same effect, but ISAPI extensions run as .DLLs, while NSAPI runs directly on the Netscape Server.

TURNING THE HTML PAGE

Expect to see new Web-page creation tools as well. Netscape's flagship content-creation product is its $79 Navigator Gold 2.0, which features a Web-page editor that provides a near-WYSIWYG view of your work. The familiarity of Navigator Gold's look and feel is offset by its inadequate support for HTML tables.

Microsoft has two current content-development offerings and one in the wings. Internet Assistant for Word for Windows, available as a free download, lets you browse and edit Web pages using the familiar Word interface. Microsoft's FrontPage ($149; $99 for Microsoft Office users; First Looks, February 20, 1996) uses a desktop publishing metaphor and is a step up the page-creation ladder; evaluation copies are available from Microsoft's Web site.

Internet Studio, which started out as a creation platform for The Microsoft Network, will likely be the company's tool for professional Web designers. When it's finished, Internet Studio will inte-

grate ActiveX controls and CSS, is expected to support a multitude of HTML extensions and VBScript, and will likely enable collaborative Web development—a Web first.

Netscape's opportunities for developers revolve around the company's browsers and servers. For instance, the Navigator browser is automatable through OLE with several object interfaces defined on its Web site *(http://home.netscape.com/newsref/std/oleapi.html)*.

EASIER-TO-SWALLOW JAVA

An environment for designing and debugging Java code is crucial to developing interactive Web content. Microsoft is building on its programming tool, Visual C++, to produce the Java-aware Jakarta environment. Third-party compiler vendors such as Borland and Symantec are already shipping Java programs that are more visual as well as "just in time" compilers to speed Java's execution.

Whose vision of the Internet's future will dominate in this war of the Web? At this point it's hard to say. Netscape's nearly universal acceptance is an enviable base from which to launch an attack, while Microsoft's Windows 95 integration and continued enhancements to HTML offer unprecedented ease of use and flexibility for developers and users alike.

No matter which company emerges as the victor, Web users will be the real winners, with rapidly evolving products that result in more interactive and interesting Web sites.

Netscape Navigator Atlas. Requires: 8MB RAM, 6MB hard disk space, Microsoft Windows 95. Netscape Communications Corp., Mountain View, CA; 415-528-3888; http://home.netscape.com. *Circle 425 on reader service card.*

Microsoft Internet Explorer 3.0. Requires: 8MB RAM, 3MB hard disk space, Microsoft Windows 95. Microsoft Corp., Redmond, WA; 800-426-9400, 206-454-2030; http://www.microsoft.com. *Circle 426 on reader service card.*

INTERNET SERVERS

At Your Service: FastTrack vs. Internet Information Server

By Tony Pompili and Robert P. Lipschutz

Even with scads of software available to anyone patient enough to wait out a multimegabyte download, the Internet today proves the old saw that there's no such thing as a free lunch.

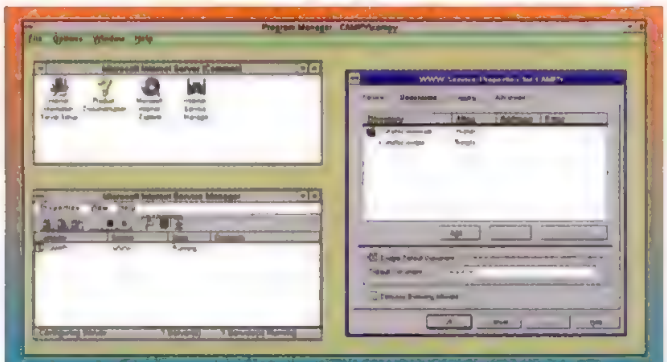
Take Microsoft Internet Information Server Version 1.0 (IIS). The Web-server software is available for free from Microsoft's Web site *(http://www.microsoft.com)* and delivers all the basics for developing a professional Internet presence. In addition to services for the Web, FTP, and Gopher, IIS offers tight integration with Windows NT, Secure Sockets Layer (SSL) security, and a copy of Microsoft's Web browser, Internet Explorer.

IIS falls short, though, in terms of platform support and administrative and content-creation tools. At first, the price may seem tough to beat, but IIS may end up costing more than other Web-server packages because of the other components you'll need.

Netscape FastTrack Server is designed for those who are more concerned with content than with the ins and outs of running HTTP servers. The $295 FastTrack package is a nonstop route to a sophisticated site, as it includes an HTTP server, Navigator Gold 2.0's authoring tools, and support for Java and JavaScript.

HERE AND NOW

At press time, IIS offered at least one major benefit over FastTrack: It is in final form. For this roundup, we looked at the beta version, 2.0b2, of FastTrack; the final product should be available by the time you read this, according to Netscape. The software is available from the company's Web site *(http://www.netscape.com)* for evaluation. These two programs take their places alongside The Internet Factory's Commerce Builder, IBM Internet Connection, Spry SafetyWeb Server, O'Reilly & Associates' WebSite, and Quarterdeck's WebStar in the crowded Web-server market.



IIS's Internet Service Manager gives you all the basic tools for administering Web servers in a familiar interface.

FastTrack provides all the features corporate customers expect, combined with easy-to-use administration and content-creation tools. Installing FastTrack is easy, as long as the server already has access to an IP network or Internet service provider.

During setup, you fill in the server name, administrator's name, and password. FastTrack's configuration wizard does the rest. We found that IIS's graphical setup routine was just as straightforward; FastTrack and IIS each took about 10 minutes to configure.

FastTrack wins the shoot-out with IIS in terms of operating-system support: FastTrack runs on Windows NT and a good selection of Unix variants: Hewlett-Packard's HP/UX, IBM's AIX, SGI Irix, and Sun's Solaris Unix. By contrast, IIS runs only on Windows NT Server, which costs $699. You can buy IIS as part of the $999 NT Server Value Pack, which includes the server software, Windows NT Server 3.51, and ten client-access licenses. What IIS lacks in terms of breadth of OS choices, it makes up for in terms of integration into Windows NT.

Both FastTrack and IIS have built-in SSL security. IIS and Internet Explorer use Netscape's SSL 2.0, and FastTrack integrates Version 3.0, which supports client-side security certificates and advanced Internet-ready access control.

As far as page-level security goes, you can designate pages on your IIS Web site as privileged locations that require user IDs and passwords for access. By contrast, FastTrack bypasses Windows NT's built-in security in favor of its own access-control system for restricting users and groups of users to specific directories.

Although this adds another layer of administration to FastTrack, it offers more flexibility compared with IIS. One benefit of Netscape's approach is the ability to apply Internet-specific access controls to a server's directories or files so that you can restrict a user to a server, directory, or filename—or any combination—based on a host name or IP address. But with IIS we were also able to block access by users based on their domain names as well.

Because IIS uses Windows NT's directory services and security system for restricting server access, there's no need to create a new list of users and groups. To add a new user, you simply create a new server account and IIS automatically recognizes the change.

FastTrack actually runs two separate services: the general Web server that clients connect to and an administration server through its own unique TCP port.

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You protect the administration server from unauthorized access with a user name and password; SSL security can also be added.

A big bonus is that you can install several instances of FastTrack on a given machine, while only one version of IIS can run on a system. This multiple-personality potential lets FastTrack users consolidate their Web farms into a single machine or just a few machines.

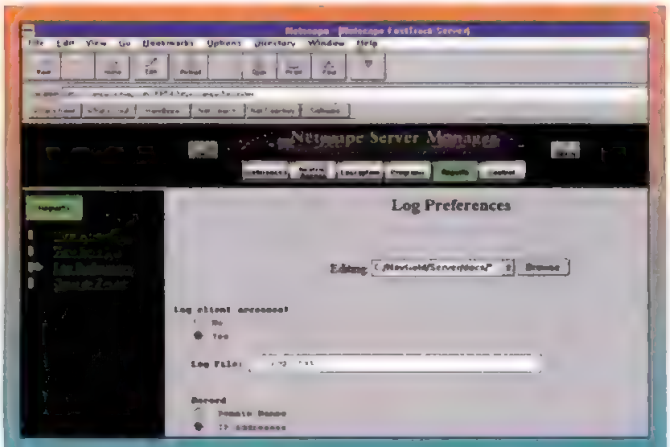
One copy of the administration server manages all of the FastTrack servers on a single system. Though this eliminates the need to jump among multiple administration programs, you're still basically administering each server individually.

With FastTrack, all administration tasks are performed through Netscape Server Manager (NSM) and your Web browser, assuming it supports frames and JavaScript; we used Netscape Navigator. On the positive side, browser-based administration lets you perform tasks anywhere on the Internet, including adding new users or even shutting down the server.

FastTrack's NSM is actually a series of JavaScript applications with frames to make it easier to navigate through the various options. Button bars in the top frame let you choose the area to administer, such as Restrict Access or Reports. NSM will also work with the forthcoming set of SuiteSpot servers, including the Enterprise Server and the Catalog, Mail, News, and Proxy servers.

The use of a browser as an administrative interface demonstrates how far Java and other browser-application languages still have to go when compared with the ease of use of drop-down menus and dialog boxes. For example, when we wanted to delete a user from a group with NSM, we had to remember the user's name and enter it manually rather than select it from a list. The final version of NSM may fix this shortcoming.

In a similar vein, NSM and IIS use a Windows NT program called Internet Service Manager (ISM) to oversee and control server functions. ISM offers similar unified management. The applications window tells you which Web, Gopher, and FTP servers are running. Right-clicking brings up a menu that allows you to start, stop, or pause the server or to view the server Properties. In the Properties view, you can define user access and directory-mapping abilities and set logging options.



Netscape Server Manager lets you control your Web servers via the Navigator browser from anywhere on the Internet.

AN EYE ON THE WEB

For monitoring, IIS includes the basic controls for logging server activity. The administration utility logs each hit and records the amount of data transferred and the TCP/IP address. IIS lets you send the report output to a SQL Server database table, and an included utility converts this data from the default Professional Internet Service log format to the NCSA Common Log File format. You can also use the utility to conduct a reverse DNS lookup to replace IP addresses with domain names.

FastTrack has the advantage of working in the Common Log File format from the start. In addition to the basic data, the report generator can give you such useful management information as application status and user log-ons.

The two servers also differ widely in terms of page-creation tools. FastTrack includes Netscape Navigator Gold 2.0, an HTML authoring tool for creating, editing, and publishing HTML documents without fussing with HTML code. Microsoft has taken a different tack, keeping IIS separate from authoring software.

Navigator Gold includes an HTML editor complete with tools for choosing colors, graphics, line styles, and type styles. Entire Web pages can be imported and used as templates for building subsequent pages. Navigator Gold supports Java and JavaScript, while none of Microsoft's authoring tools yet support either Java or JavaScript.

Netscape also provides a collection of page-creation wizards and templates for FastTrack, available from the company's Web site. These wizards prompt you for the page graphics, style, and text. Templates provide you with predesigned pages that you can modify. These components will be incorporated into Netscape LiveWire, which is scheduled to ship at the same time as FastTrack. LiveWire, which also includes ODBC (Open Database Connectivity) drivers and improved site management tools, can be purchased with FastTrack for $495.

Microsoft offers three options for HTML authoring, neither of which is included with IIS: the downloadable Internet Assistant for Word for Windows; the $149 FrontPage 1.0, which Microsoft recently purchased from Vermeer Technologies; and the forthcoming industrial-strength Internet Studio. (For more information, see "The Browser Battle Between Microsoft and Netscape" on page 40.)

FastTrack supports CGI scripts and Netscape's own CGI alternative, called NSAPI. For those who prefer working with Visual Basic, FastTrack also works with WinCGI for communicating between Visual Basic apps and the server. IIS also supports CGI scripts and Perl, and it includes support for Microsoft's Internet Server API (ISAPI).

Most Web servers use ODBC to link Web sites with databases. LiveWire uses ODBC for SQL Server, but opts for native drivers for Illustra, Informix, Oracle, and Sybase databases. For IIS, Microsoft's Internet Database Connector (IDC) has ODBC drivers for accessing SQL Server, Microsoft Access, Informix, Oracle, Sybase, and other databases.

PRICE AND COST

Head-to-head comparisons are hard to make. Though FastTrack has the advantage in terms of operating-system support, security, and the ability to run several servers on one physical system, IIS has the lead in terms of integration with Windows NT and an unbeatable up-front price. For those already running a Windows NT shop, IIS is a logical, thrifty choice.

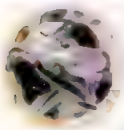
For others who haven't standardized on Windows NT and don't have a lot of time to fiddle around with Web servers and HTML tags, FastTrack is an attractive alternative to IIS. At $495, the LiveWire package is an even better value for those who need an HTML editing package as well.

Netscape FastTrack Server. List price: $295; with LiveWire, $495. Requires: 16MB RAM, 20MB hard disk space, Microsoft Windows NT or Unix. Netscape Communications Corp., Mountain View, CA; 415-937-3777, 415-937-2555; http://home.netscape.com. *Circle 423 on reader service card.*

Microsoft Internet Information Server Version 1.0. List price: Free; FrontPage, $149. Requires: 16MB RAM (CD-ROM version, $99), 5MB hard disk space, Microsoft Windows NT. Microsoft Corp., Redmond, WA; 800-426-9400, 206-882-8080; http://www.microsoft.com. *Circle 424 on reader service card.*

NAVIGATOR PLUG-INS

Get Plugged In: Navigator Plug-Ins That Liven Up the Web

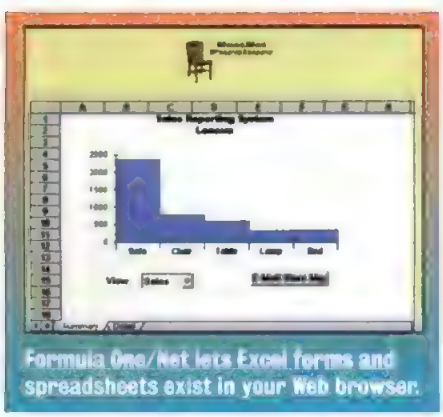


By John Morris and Sebastian Rupley

As Microsoft ramps up its Internet strategy to compete with Netscape for ownership of tomorrow's interactive Web, Netscape Navigator plug-ins are here today. These applets come in an array of shapes and sizes and have managed to infuse the Internet with a new level of interactivity.

Since our last look at plug-ins ("Internet Plug-Ins and Helpers," May 14, 1996), we've uncovered many glitzy, ambitious, and useful newcomers to the Navigator plug-in party. All of them turn the concept of a static Web on its head.

You'll find applications (most of which install themselves) that have surprising capabilities to extend the Web, from translation software that automatically converts your English Web page to a foreign tongue—or vice versa—to a conferencing application to a universal video player to an Excel-compatible spreadsheet. Other plug-ins add sound or animation.



Formula One/Net lets Excel forms and spreadsheets exist in your Web browser.

The common denominator of these Navigator plug-ins is that they bring us closer to the next phase in the evolution of Web content: interactive sites that are overflowing with multimedia.

COOLTALK

Insoft's CoolTalk (*http://ice.insoft com/*) is a near-real-time audio- and data-collaboration tool for the Web. CoolTalk provides full-duplex audioconferencing, a Web first, so that two users can speak and be heard at once.

Some of the interesting aspects of CoolTalk are an answering-machine feature for recording audio and a mute button for when, say, your dog is barking in the background. The product's freehand drawing tools are useful but require a digitizing tablet to work well; the magnification tools are excellent for enlarging regions of a document.

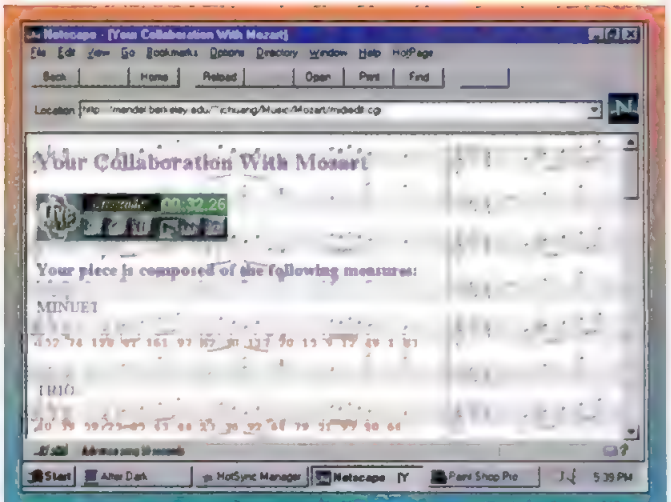
Despite its full-duplex capabilities, we found that—as with most teleconferencing systems—CoolTalk worked best if one user spoke at a time. Audio was often choppy, but CoolTalk proved to be an adequate Internet-based competitor to standalone whiteboard/conferencing packages. We found that CoolTalk worked best over a 28.8-Kbps modem.

At $49.95 (or $69.95 for two copies), CoolTalk makes the connection at a much lower price than that of most other teleconferencing programs.—*SR*

CRESCENDO PLUS

LiveUpdate, a division of Labtech, is aiming to inject a little audio into the Web with its MIDI plug-in, Crescendo Plus. Available for $19.95 from the company's Web site (*http://www.liveupdate.com*), Crescendo Plus is a viable alternative to Progressive Networks' RealAudio; a light version, Crescendo, is available as a free download.

Compared with RealAudio, Crescendo technology requires no special server software and bypasses proprietary compression in favor of MIDI. A 1-minute MIDI file is typically 10K to 20K, while even short .WAV files can take up megabytes.



With Crescendo Plus and a few downloadable MIDI music files, you can make Web pages sing.

Like RealAudio, Crescendo Plus utilizes streaming so you don't have to wait for the entire file to download before it can start playing. To get a taste of Crescendo, try visiting LiveUpdate's Cool Site of the Day section, MIDI Central (*http://www.tstmedhat.com/~neburton*) or MIDI Classics (*http://www.midi-classics.com*).

When you get to a site that uses Crescendo background sound, the music automatically begins playing and the Crescendo Plus control panel pops up. The control panel has a timer and buttons to play, stop, fast forward, or rewind the MIDI track.

Crescendo Plus costs less than Xing's StreamWorks and is more compact than RealAudio, and its player module is more flexible than The DSP Group's Editors' Choice–winning TrueSpeech Internet ("Sound Blasts the Web," March 26, 1996). Crescendo Plus also has the advantage of working with MIDI files, not some exotic compression technology.—*JM*

FORMULA ONE/NET

Visual Components' Formula One/Net (*http://www.visualcomp.com/f1net/download.htm*) is a plug-in that lets you embed Excel-compatible spreadsheet applications within Navigator and could usher in an era of interactive Internet-based spreadsheet applications.

A great way to share data without having to rely on a CGI script, Formula One/Net is fully compatible with Excel 7.0 spreadsheets and can be linked to an ODBC database. Visual Components' home page includes several examples of Web-based interactive spreadsheets and forms that can be viewed and edited directly within Navigator.

During testing, we found Formula One/Net was surprisingly fast at intensive tasks such as big recalculations, although we didn't find it as snappy as Excel at working with charts on a standalone PC.

If you're seeking a way to feed spreadsheet data to a Web browser or create an interactive form, look no further than Formula One/Net.—*SR*

NET TOOB

Duplexx Software's Net Toob Multimedia Pager is a one-stop solution for viewing video or animation, from .AVI, .MOV, and .MPG video files to .FLC and .FLI animation files.

Rather than requiring you to download video files and view them externally, Net Toob automatically plays them from within your browser. It has a simple, intuitive VCR-like interface, auto-

Continues on page 48

STATISTICA

Windows 3.1 and WINDOWS 95

STATISTICA (automatically configures itself for *Windows* 95 or 3.1) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive *Windows* support, OLE (client and server), DDE, customizable *Auto Task* toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with *data-graph* links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing, multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; correspondence analysis; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte Carlo* simulations; and much more ■ On-line *Electronic Manual* with comprehensive introductions to each procedure and examples ■ Hypertext-based *Stats Advisor* expert system ■ Workbooks with multiple *AutoOpen* documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop*, *AutoFill*, *Auto-Recalculate*, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful *STATISTICA BASIC* language (professional development environment) with matrix operations, full graphics support, and interface to external programs (*DLLs*) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating *Auto Task* toolbars ■ All output displayed in Scrollsheets™ (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. *ODBC* access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, *Multiple-Graph AutoLayout Wizard*, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price **$995.**

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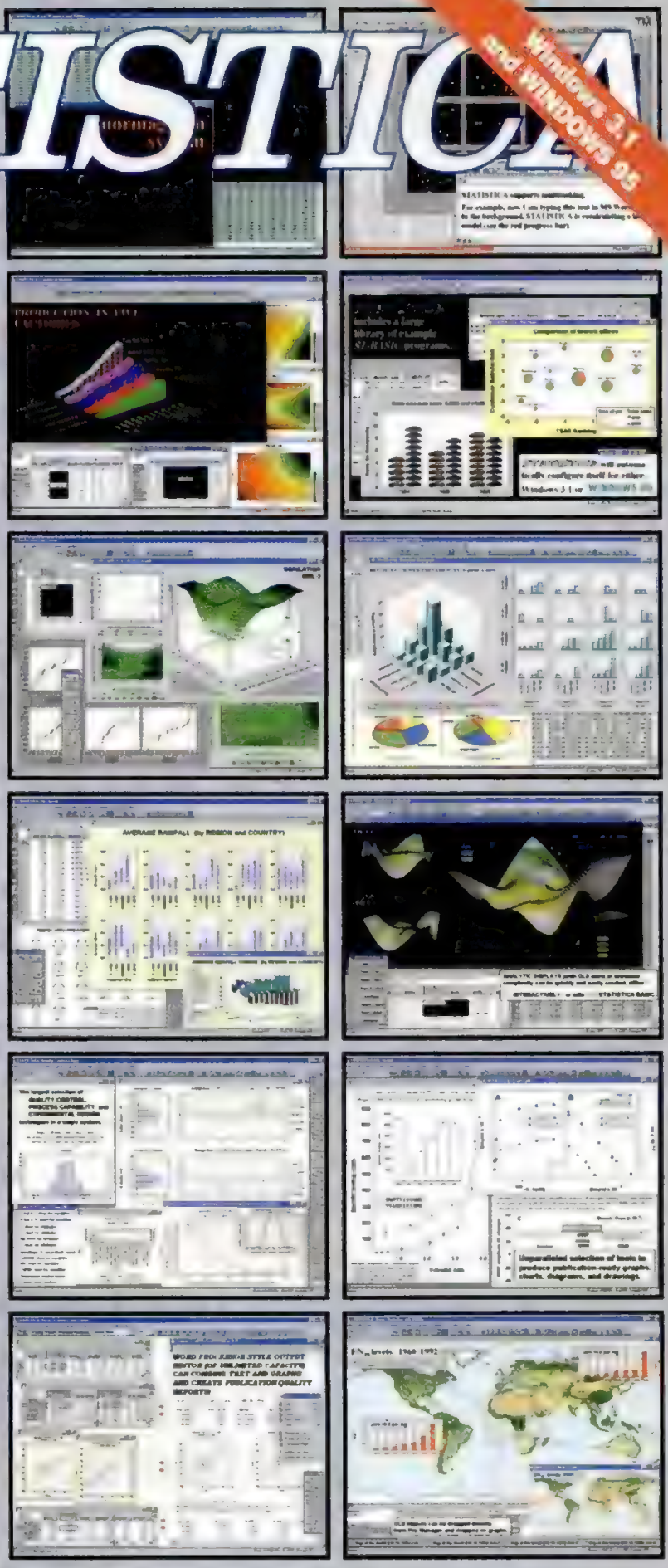
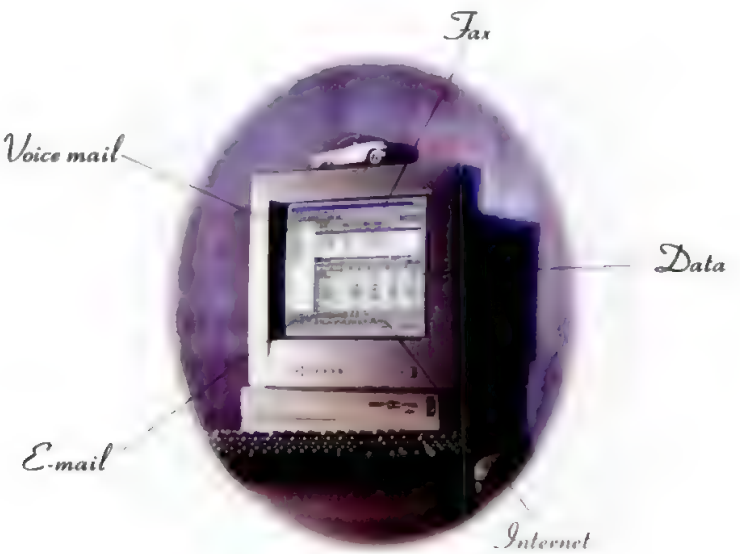


We've changed the dreaded, backbreaking, mind-numbing, painful task of communicating through your computer.

(All right, slight exaggeration.)

Introducing FocalPoint

O.K, so maybe communicating through your computer isn't something you'd consider incredibly taxing and laborious, but it can be, shall we say, a major hassle.



That's why Global Village, the maker of award-winning FaxWorks™ software, has introduced FocalPoint™ integrated communications software. Only FocalPoint lets you fax, transfer files, exchange e-mail, access the Internet and manage phone calls all from one window on your computer, making communicating easier than ever.

Because FocalPoint integrates all of these full-featured capabilities, you don't have to constantly switch between applications. To get all of your messages, you check a single in-box. You only need to manage one address book, as well. And you can also create a single message, address it to multiple people and the message will be sent out in the preferred method for each person, like e-mail, fax, what have you.

FocalPoint is fully compatible with both Windows® 3.1 and Windows 95, so visit your local reseller and give it a try.

Or, call 800.436.6752 ext. 1266 for a free trial copy on CD-ROM and visit our Web site at http://www.globalvillage.com/fp6/ for more information.

If you're not too tired.

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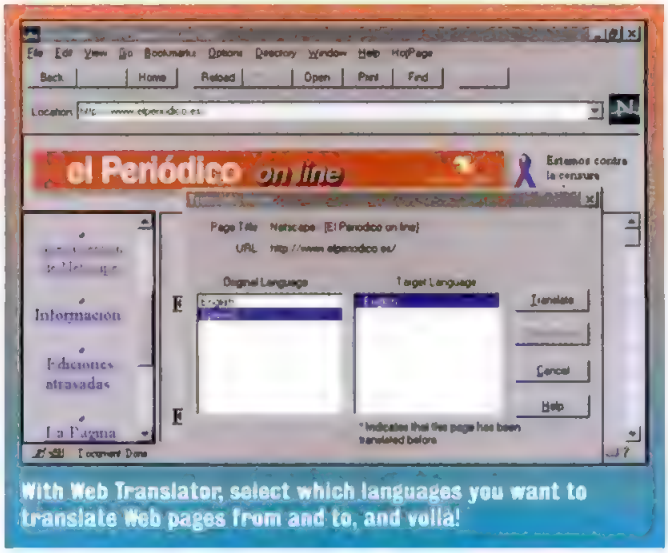
matically sets up within Navigator, and handles audio well.

We played several .MPG files at 7.5, 15, and 30 frames per second and observed little image degradation, even at the fastest frame rate. Running Net Toob at one-eighth-screen size produced better video quality than one-quarter-screen or full-screen. As with other video plug-ins, Net Toob has a fuzzy look at full-screen size.

We were quite impressed with Net Toob's all-around abilities. A demonstration version, which remains active for two weeks before requiring registration and payment, is downloadable at *http://www.duplexx.com*. The $14.95 cost of Net Toob is a small price to pay for the convenience that it provides.—*SR*



With Web Translator, select which languages you want to translate Web pages from and to, and voilà!

QUICKSILVER

QuickSilver is a plug-in that allows you to use Micrografx Designer to create and display vector-based Web graphics. QuickSilver, which can be downloaded free from Micrografx's Web site (*http://www.micrografx.com*), lets you go beyond viewing to transform just about any graphics image into an interactive online object.

QuickSilver lets you open and view vector files, which the program calls Objects, that have been created in a variety of formats: Micrografx Designer's .DSF and CorelDraw's .DRW and .DS4. To work with and manipulate these Objects, you must also have the $299.95 ABC Graphics Suite 95 (First Looks, November 21, 1995).

By comparison, Corel Corp.'s CMX Viewer (*http://www.corel.com/corelcmx*) and Electronic Book Technologies' FIGleaf Inline (*http://www.ct.ebt.com/figinline*) both support viewing of vector graphics, but QuickSilver also allows you to turn graphics into interactive objects without fussing with HTML coding.

QuickSilver works by having you select an illustration in one of the supported formats, click on the Object menu item, and select Properties. In the Properties dialog box, you can assign a URL for the Web object to jump to or have the object perform several other Web tricks.

In addition to letting you view vector illustrations on the Web, QuickSilver can also inject a level of interactivity by transforming them into live objects.—*JM*

SIZZLER

Totally Hip's Sizzler is an animation package that can add snap, crackle, and pop to your Web pages. Sizzler allows you to view animated sprites from within your Web browser.

Sizzler is a plug-in for viewing Sizzler sprites; there's also the Sizzler Editor, which has controls for cell-by-cell editing. The editor, which is currently an alpha product, will eventually include file converters for .AVI and .FLI formats, according to Totally Hip (*http://www.totallyhip.com*), so you don't have to start from scratch.

The plug-in is based on Object Scenario technology, which can stream applications at low data-transfer rates without taxing system memory or using a lot of hard disk space. Sizzler sprites are interlaced so that images appear in full animation almost immediately and gradually become sharper as the download proceeds.

We were able to open sprite files in the Sizzler Editor and view their components in the editor's Explorer-like Tree View window. We also adjusted the sprite's

Continues on page 51

Three of a Kind: Plug-Ins, ActiveX, and Java

Say good-bye to dull, static pages, because the Web is all about interactivity. Say hello to immersive Web worlds that are alive with information. Although Netscape had the early lead in enabling interactivity—with the Navigator Plug-In architecture and support for Sun's Java—Microsoft is coming up fast with its own take on the interactive Web.

The Navigator plug-ins we evaluated work by displaying and allowing you to interact with MIME (multipurpose Internet mail extension) data. Having ignored Navigator plug-ins to this point, Microsoft now says that it will support this architecture soon.

Microsoft's Web vision involves ActiveX, a mix of old and new. ActiveX controls are basically OLE custom controls (.OCXs) with a few new interfaces that support Internet-related functions.

ActiveX relies on the existing OLE programming infrastructure, which provides two routes to an interactive Internet. One is to use an OLE Document Object, or DocObject, as a generic container. For example, Internet Explorer could evolve into a DocObject container and then add Excel (which can function as a DocObject server), and voilà—your Web browser is now capable of creating, viewing, and editing Excel spreadsheets natively.

ActiveX controls can also function as servers. Microsoft's unreleased DCOM (Distributed Common Object Model) standard, for example, will allow client and server controls to communicate with each other and distribute the workload across multiple networked systems. Microsoft's preproduction development environment, Visual C++ 4.1, includes new frameworks and AppWizard support for building Internet-server applications using Microsoft's ISAPI.

ActiveX also permits scripting, so that Web pages have controls whose behavior is automated from within the browser; ActiveX controls can even interact with each other. In addition, VBScript—a subset of Microsoft's programming language, Visual Basic—will be available as an ActiveX Scripting interface; eventually, we expect ActiveX Scripting implementations of Perl and JavaScript.

Java, perhaps more than any other technology, is associated with Web interactivity. An object-oriented programming language descended from C++, Java has been used to enable give and take between client and server, such as stock and sports tickers and interactive product finders. Navigator already directly supports Java, and Microsoft says its products will work with Java by using a wrapper that makes Java code look like an ActiveX control.

Web developers have no shortage of ways to turn the Internet into a two-way street.—*John Clyman and Larry Seltzer*

PC
Talk
With Kate & Jack
On The Road
GATEWAY OR BUST!
PCQA

PC Talk

With Kate & Jack

Kate: Good morning and mega power from South Dakota! This is "PC Talk with Kate and Jack — On the Road" broadcasting live from Gateway 2000 headquarters in North Sioux City, South Dakota.

When we heard that Gateway had developed a whole new computer category for the entire family, we decided to jump in the PCQA mobile and check it out for ourselves. All this fresh Midwestern air has us perkier than a double espresso! Aren't you glad I scored that invite from Gateway 2000 Chairman and CEO Ted Waitt?

Kate: Yeah, yeah, whatever. Let's tell the folks out there about the coolest thing we've seen today at Gateway. When we first walked into the cow-spotted mega building, we heard this incredible booming stereo sound. It sounded like a movie theater, and it was coming from a dark secluded area.

We looked inside, and lo and behold, there was a honkin' Destination31 monitor (31" viewable) — just like the one delivered to the station the day we talked to Ted.

The Destination® Big Screen PC features a fast Pentium® processor, cable-ready TV tuner, Destination31 monitor (31" viewable), wireless keyboard and Field Mouse™ remote, and Destination Software Collection starting at only $3,499.

Kate: But this was more than just the monitor, it was the whole Destination Big Screen PC including the fabulous wireless keyboard and Field Mouse™ remote! The Gateway crew had put it in an entertainment center and built a family room setting in their test lab. When we got there, at least a dozen people were lounging on the sofa and playing the sports car game *The Need For Speed.*™

Jeff from Jersey City is dying to get through on the phone. Fire away, Jeff!

Jeff: You've seen the Destination system? I've been wild to get one ever since I heard Gateway was coming out with it.

Kate: Now's your chance, Jeff. **The Destination Big Screen PC has blown the PC market open with a totally new category of computer. Gateway's Destination Big Screen PC is the result of the convergence of the PC and the TV — it will revolutionize computer use in the home.**

intel inside pentium PROCESSOR

Yeah, it's designed for the family room and is perfect for anyone who wants to share their computing experience with others — even if it's just one other person. Mary from Miami, you're on!

Mary: *What's the deal with these "wireless devices?"*

Kate: They function exactly like your standard keyboard and mouse but without the wires. You can use them while lounging on the couch, walking around or standing in back of a group of people. Because they use radio frequency technology, these wireless devices have more range than an all-star shortstop.

Mary: *Sounds like they are just as convenient as my TV remote.*

Even more so, Mary. **With the wireless keyboard and Field Mouse remote, you don't have to point at the monitor like you do with a traditional remote.** The keyboard and mouse have all the buttons you need to control every function.

Don't forget anything you can do with a TV, you can do with the Destination system — run cable TV to it, connect your satellite dish or VCR, even your laser disc system or game machine. Plus the Destination Big Screen PC is designed to work with your stereo system, so you'll experience the quality sound you receive from your stereo.

Mary: *Can the Destination system still function as a basic computer system?*

Kate: *Absolutely.* **It has all the horses of a Pentium processor with plenty of RAM and a huge hard drive.** Plus it's chained to a fast CD-ROM drive. Happy computing!

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Stan: *I love it! It's great to be part of a company that cares about its customers and its employees. This place has an unbelievable team spirit.* ***We have a good time, but we know that our first priority is to send quality, high-performance PCs out the door every day.*** *We're really into quality assurance — in fact, our manufacturing facility here in North Sioux City is ISO 9002 certified.*

Kate: Hey, look over there. Is that who I think it is?

It's Gateway Chairman and CEO Ted Waitt.

Ted: *Kate and Jack! Thanks for coming to visit us out here.*

This is where all the hot PC industry news is, Ted. Thanks for getting us a look at the new Destination® Big Screen PC and the rest of your amazing products. Hey, I noticed your office is upstairs. Do you get down here often?

Ted: *Now and then. I started out in manufacturing — along with sales and technical support, plus a little engineering, a little advertising, a little shipping — you name it, I've done it. We all work as a team here to provide our customers with the latest technology at a great price.*

Kate: After seeing the amazing energy of your team, now I know how you bring high quality products to the market at such incredible values.

Ted: ***It's the employees who set us apart. They take pride in what they do, and have a lot of ideas on how we can make our products better.*** *We're dedicated to making sure every PC that goes out the door is a quality machine. Every Gateway employee worldwide takes this responsibility very seriously.*

Whoa! That's quite a concept!

Ted: *I hope you had a good time today. Stay as long as you like, but you might want to check out the PCQA mobile.*

Kate: Why's that, Ted?

Ted: *Well, the folks painting cow spots on the building got carried away. Your PCQA mobile is now cow spotted!*

Cool! Now we're part of the Gateway family. C'mon, Kate — let's cruise!

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- 86-Key MS Windows® 95 Keyboard
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- MS Works 95
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- Modular 3.5" Floppy Drive
- Integrated 16-Bit Sound with Stereo Speakers
- 1MB Video RAM
- Lithium Ion Battery & AC Pack
- EZ Pad Pointing Device
- 86-Key MS Windows 95 Keyboard
- Parallel, Serial, Infrared, VGA & PS/2 Ports
- Built-In Mic, Headphone and Line-In Jacks and External Volume Control Dial
- 11.8" x 8.8" x 2.0"
- Microsoft Windows 95
- MS Office 95, Professional Edition*
- Carrying Case

$3799

S5-90XL

- **11.3" SVGA Color Display**
- 90MHz Intel Pentium Processor
- 16MB RAM (expandable to 40MB)
- 256K L2 Pipelined Burst Cache
- 810MB Hard Drive
- Modular 4X CD-ROM Drive
- Modular 3.5" Floppy Drive
- Integrated 16-Bit Sound with Stereo Speakers
- 1MB Video RAM
- Lithium Ion Battery & AC Pack
- EZ Pad Pointing Device
- 86-Key MS Windows 95 Keyboard
- Parallel, Serial, Infrared, VGA & PS/2 Ports
- Built-In Mic, Headphone and Line-In Jacks and External Volume Control Dial
- 11.8" x 8.8" x 2.0"
- Microsoft Windows 95
- MS Office 95, Professional Edition*
- Carrying Case

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S5-120XL BEST BUY

- **11.3" SVGA Color Display**
- 120MHz Intel Pentium Processor
- 40MB RAM
- 256K L2 Pipelined Burst Cache
- 1.2GB Hard Drive
- Modular 4X CD-ROM Drive
- Modular 3.5" Floppy Drive
- Integrated 16-Bit Sound with Stereo Speakers
- 1MB Video RAM
- Lithium Ion Battery & AC Pack
- 28.8 PCMCIA Fax/Modem
- EZ Pad Pointing Device
- 86-Key MS Windows 95 Keyboard
- Parallel, Serial, Infrared, VGA & PS/2 Ports
- Built-In Mic, Headphone and Line-In Jacks and External Volume Control Dial
- 11.8" x 8.8" x 2.0"
- Microsoft Windows 95
- MS Office 95, Professional Edition*
- Carrying Case

$5599

OPTIONS

- PCMCIA 28.8 Fax/Modem **$229**
- PCMCIA 14.4 XJACK® Fax/Modem **$119**
- Solo Docking Bar **$150**
- 3-Year Limited Warranty **$100**

(For a free copy, call or write.)

The Gateway Solo line starts at 5.4 lbs. Weight includes 8MB RAM, 810MB hard drive, Lithium Ion battery & option bay cover.

GATEWAY2000

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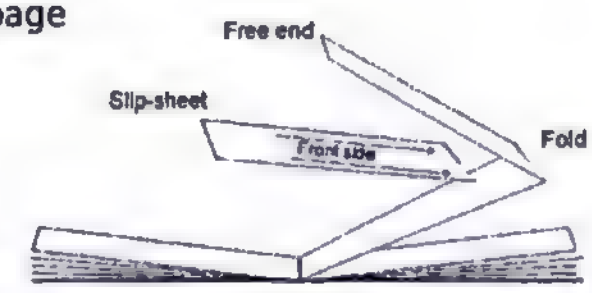
Portable Sales

Folded edge of the page

GbsSlipSheet-001

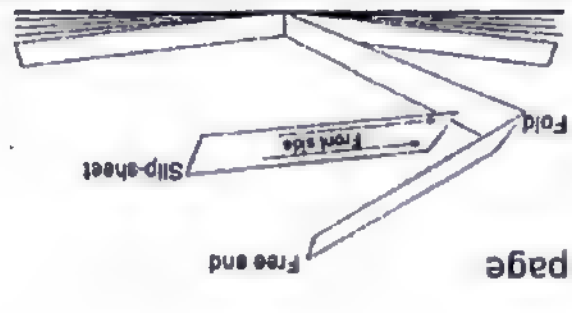
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



GbsSlipBack-0018

Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

We're sitting here in the shadow of the Destination® Big Screen PC — staring at the whoppin' 31-inch VGA monitor and fooling with the fabulous wireless devices. Kate's so comfortable with the keyboard on the couch, that she's dashing off e-mail to her mom. Tom from Tampa, you're on the air with Kate and Jack!

Tom: *Mega power, Jack. I had planned to purchase a Gateway P5-166XL multimedia in a couple weeks. But now I'm considering a Destination Big Screen PC. What options do I have?*

Gateway 2000 had its valued customers, like you, in mind while they were designing this new product, so they came up with the Destination Big Screen PC package. It's very simple to convert a Gateway Multimedia system into a Destination Big Screen PC. You get the Destination31 color monitor (31-inch viewable), Destination 2MB VRAM graphics accelerator with cable-ready TV tuner, hi-fi wavetable audio card, four-channel wireless keyboard with integrated EZ Pad™ pointing device and wireless Field Mouse™ remote, and Destination software collection. Your sales rep can give you the entire scoop. Thanks for calling, Tom!

Kate: Mike from Memphis wants to talk about the burly power of Gateway's G6 machines.

Mike: *Sounds like Gateway is moving into the family room big time with its Destination Big Screen PC. But don't forget their workstations.* ***That Gateway G6-150 is one of the best workstation values in the industry — I just ordered another one today for my accounting business.***

Wow! Tell us more!

Mike: *I need an ultra-high performance PC with MS Windows® NT™ 3.51 to squeeze every speck of performance out of 32-bit software applications like those in Microsoft® Office 95, Professional Edition.* ***The G6-150 was the perfect solution for my intensive computing. The clincher was the price — just $3,199.***

Yow, that's an intense value, Mike. I bet the accounting crew at the station is drooling at the thought of a 32-bit screamer at such an amazing price. And Gateway customers can also upgrade their Pentium® processor-based desktop PCs to Windows NT 3.51 for an additional $99. MS Windows for Workgroups 3.11 is also available on Gateway's Intel® Pentium processor-based desktop and portable systems. Thanks for the call, Mike!

I just met Jennifer who works in engineering when I noticed the huge screen image on her Gateway Solo™ portable PC.

Jennifer: *We've upped the ante in high-quality portable PCs by offering an even bigger screen.* ***All Gateway Solo portable PCs are now available with 11.3-inch active matrix SVGA color screens — a 17% increase in viewable screen area compared to the 10.4-inch screen.***

Kate: Amazing. Gateway has come out with a ton of cool stuff on their Solo portable PCs like the modular 4X CD-ROM drive, the EZ Pad™ pointing device and now this humongous new screen. What will they come up with next? Tory from Tulsa, you're on the air!

Tory: *I've had my Gateway Solo S5-75XL portable PC for just a couple of weeks, but I'm already nuts about it.* ***It has all the capabilities of a desktop PC in a portable package — a powerful Pentium processor, 8MB RAM, 256K pipelined burst cache, plus 16-bit sound and speakers.*** *And like all Gateway Solo portable PCs it has a modular 4X CD-ROM drive that whips through multimedia apps in no time, plus when I want to kick back, I can just drop in my favorite CD. All that for only $2,899.*

Kate: **That's a hot price for a multimedia portable PC. And that 4X CD-ROM drive is a screamer — it's one of the fastest CD-ROM drives you can find in a portable PC.** Thanks for the call!

Jennifer: *Hey, you guys can't leave without seeing manufacturing. That place is always hopping!*

Sounds good. We're heading down there right now!

Kate: Jennifer was right, manufacturing is rockin.' As we speak, I'm holding the packing slip for a PC ordered by Kay from Kansas City. **She's getting a P5-166XL multimedia PC complete with an 8X EIDE CD-ROM drive and a 2.5GB EIDE hard drive. I didn't think this stuff was even on the market yet.**

Let's get a word with Stan. He's one of the assembly technicians putting the final touches on Kay's mean multimedia machine. So Stan what's it like to work for the nation's leading direct PC marketer?

Multimedia Systems

P5-100 FAMILY PC™

- Intel® 100MHz Pentium® Processor
- 8MB EDO Performance DRAM
- 850MB 10ms EIDE Hard Drive
- 1MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X CD-ROM Drive/3.5" Diskette Drive
- 16-Bit Gateway Sound Card
- Altec™ Lansing ACS-40 Speakers
- TelePath® 28.8 Fax/Modem
- CrystalScan®15 .28dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- Microsoft® Windows® 95
- Generations II Software Collection

$1899

P5-120 FAMILY PC

- Intel 120MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 1.62GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 6X CD-ROM Drive/3.5" Diskette Drive
- 16-Bit Gateway Sound Card
- Altec Lansing ACS-40 Speakers
- TelePath 28.8 Fax/Modem
- Vivitron™15 .26dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

$2349

P5-133 FAMILY PC

- Intel 133MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 2.5GB 10ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator with MPEG Video Scaler
- 8X CD-ROM Drive/3.5" Diskette Drive
- 16-Bit Gateway Sound Card
- Altec Lansing ACS-40 Speakers
- TelePath 28.8 Fax/Modem
- CrystalScan17 .28dp Monitor (15.7" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- Generations II Software Collection

$2799

P5-166XL

- Intel 166MHz Pentium Processor
- 16MB EDO Performance DRAM
- 512K Pipelined Burst Cache
- 2.5GB 10ms EIDE Hard Drive
- Matrox® 2MB WRAM Graphics Accelerator w/ MPEG Video Scaler
- 8X CD-ROM Drive/3.5" Diskette Drive
- 16-Bit Ensoniq® Wavetable Sound Card
- Altec Lansing ACS-400 Speakers w/ ACS-250 Subwoofer
- TelePath 28.8 Fax/Modem
- Vivitron17 .26dp Monitor (15.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition*
- Generations II Software Collection

$3599

Destination® Big Screen PCs

D5-100

- Same as P5-100 Family PC System w/ Destination Big Screen PC package replacing corresponding standard components and software

$3499 *(details on next page)*

D5-120

- Same as P5-120 Family PC System w/ Destination Big Screen PC package replacing corresponding standard components and software

$3799 *(details on next page)*

D5-133

- Same as P5-133 Family PC System w/ Destination Big Screen PC package replacing corresponding standard components and software

$4199 *(details on next page)*

D5-166

- Same as P5-166XL Multimedia System w/ Destination Big Screen PC package replacing corresponding standard components and software

$4699 *(details on next page)*

Professional Systems

P5-75

- Intel 75MHz Pentium Processor
- 16MB EDO Performance DRAM
- 850MB 10ms EIDE Hard Drive
- 1MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X CD-ROM Drive/3.5" Diskette Drive
- Vivitron15 .26dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition*

$1799

P5-120

- Intel 120MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 1.62GB 9ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 6X CD-ROM Drive/3.5" Diskette Drive
- Vivitron15 .26dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition*

$2099

P5-133

- Intel 133MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 2.5GB 10ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 8X CD-ROM Drive/3.5" Diskette Drive
- Vivitron15 .26dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition*

$2349

P5-166

- Intel 166MHz Pentium Processor
- 16MB EDO Performance DRAM
- 256K Pipelined Burst Cache
- 2.5GB 10ms EIDE Hard Drive
- 2MB DRAM, 64-Bit PCI Graphics Accelerator
- 8X CD-ROM Drive/3.5" Diskette Drive
- Vivitron15 .26dp Monitor (13.9" viewable)
- 7-Bay Mini Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows 95
- MS Office 95, Professional Edition*

$2699

Workstations

G6-150

- Intel 150MHz Pentium Pro Processor
- 16MB DRAM
- 256K Internal Cache
- 2.5GB 10ms EIDE hard drive
- Matrox 2MB WRAM Graphics Accelerator w/ Video Scaler
- 8X CD-ROM Drive/3.5" Diskette Drive
- Vivitron15 .26dp Monitor (13.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows NT™ Workstation 3.51 or MS Windows 95
- MS Office 95, Professional Edition*

$3199

G6-200

- Intel 200MHz Pentium Pro Processor
- 64MB DRAM
- 256K Internal Cache
- 2GB Fast SCSI 9ms Hard Drive
- Matrox 4MB WRAM Graphics Accelerator w/ Video Scaler
- 4X SCSI CD-ROM Drive
- 3.5" Diskette Drive
- Vivitron21 Monitor (19.9" viewable)
- 12-Bay Tower Case
- 104+ Keyboard & MS Mouse 2.0
- MS Windows NT Workstation 3.51 or MS Windows 95
- MS Office 95, Professional Edition*

$6499

** MS Office 95, Professional Edition includes Word, Excel, PowerPoint® presentation graphics program, Schedule+, Access database and Bookshelf® '95.*

All systems standard with Gateway Gold™ Service & Support

Gateway 2000 Manufacturing, North Sioux City, South Dakota, is ISO 9002 certified.

REGISTERED COMPANY ISO 9002 BGS

GSA Schedule # GS-00K-94-AGS-5150-PS01

Generations II SOFTWARE COLLECTION

■ Microsoft Encarta® 96 ■ MS Cinemania® '96 ■ MS Julia Child: Home Cooking with Master Chefs ■ MS Bob,™ For Gateway 2000 ■ MS Works 95 ■ MS Publisher 95 ■ MS Money 4.0 ■ MS Golf 2.0 ■ MS Music Central™ 96 ■ MS CD Sampler ■ MS Entertainment Packs 1-4 (31 fun games!) ■ Ca$h Graf Home Office Plus™ ■ Mayo Clinic® Family Health Book ■ Mediamatics Arcade™ MPEG Player ■ The Masters®: Interactive Journey Through Its 60-Year History, for MPEG

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Hi-Fi Extras!

Destination® Big Screen PC Package

NEW

Your family room will never be the same — the ultimate combination of television and computers has arrived! Turn a Gateway Multimedia system into the Destination Big Screen PC. The Destination Big Screen PC package specified below replaces the corresponding standard components and software of the multimedia PC you choose. All external components are charcoal colored.
(Available at time of system purchase only.)

Destination Big Screen PC Package

- Destination31 VGA monitor (31" viewable)
- Destination 2MB VRAM graphics accelerator w/ cable-ready TV tuner* featuring vertical line doubling
- 16-bit hi-fi Wavetable audio card w/ signal to noise ratio ~ 83db
- Wireless keyboard w/ integrated EZ Pad™ pointing device, wireless Field Mouse™ remote w/ integrated trackball and four-channel RF receiver
- 7-bay charcoal-colored PC rack-mount cabinet
- Speakers not included
- **Destination Software Collection**
  - Microsoft® Encarta® 96
  - Nickelodeon™ Jr. Play Math!™
  - MS Magic School Bus™: Solar System
  - The Hive™
  - You Don't Know Jack™ *(may not be suitable for children)*
  - Gateway Information Highway CD
  - Hansel & Gretel *and The Enchanted Castle*™
  - Harman Interactive SmartTV™ Programming Guide
  - 3D Atlas
  - Quicken® SE
  - 3D Monopoly™
  - The Need For Speed™
  - Launch Magazine, v. 6
  - MS Plus Pack
  - MS Cinemania® '96
  - MS Works 95

**This television receiver provides display of television closed captioning in accordance with section 15.119 of the FCC rules.*

Destination Big Screen PC Peripheral Options:

- harman/kardon High-Fidelity Sound System
Seven-piece Dolby® Prologic surround sound speaker system including AVR-10 audio/video receiver, subwoofer, center channel, and four satellites for the ultimate home stereo experience.
$699

Multimedia/Communication

- 8X EIDE CD-ROM Drive
$100 *(upgrade from systems with a 6X CD-ROM drive)*
- Altec Lansing ACS-250 Subwoofer
$75 *(upgrade from PCs that include Altec ACS-40 speakers)*
- Altec ACS-400 Speaker System w/ ACS-250 Subwoofer
$120 *(upgrade from PCs that include Altec ACS-40 speakers)*
- TelePath® 28.8 Fax/Modem
$149

Networking

3Com® Ethernet Adapters

- 16-bit Triple Media Card with BNC, AUI and RJ-45 connectors **$99**
- 16-bit Card with only RJ-45 connector **$79**

SMC® ISA Ethernet Adapters

- 16-bit Triple Media Card with BNC, AUI and RJ-45 connectors **$79**
- 16-bit Card with only RJ-45 connector **$59**

Software

Microsoft® Windows® 95 Upgrade

$79 *(On diskettes $89)*

Kid's BackPack™ II

Includes What is a Bellybutton?; The Tales of Peter Rabbit; Cinderella, The Original Fairy Tale; Freddi Fish™ and the Case of the Missing Kelp Seeds™; Pocahontas Reading Adventure, and a Gateway cow-spotted backpack. **$59**

Finance Pack

Includes Quicken Deluxe 5, Quicken® Financial Planner,™ Quicken Family Lawyer,™ and Quicken Parents' Guide To Money.™ **$69**

Gateway Gamer's Pack

Includes Command & Conquer,™ Virtual Pool™: Straight/8, The Journeyman Project 2®: Buried in Time,™ Terminal Velocity,™ Primal Rage,™ and a Gravis™ GamePad.™ **$79**

Flight Pack II

Includes Comanche™ 2.0, EF 2000,™ Su-27 FLANKER,™ Flight Unlimited,™ U.S. Navy Fighters,™ and MS SideWinder™ joystick. **$99**

Sports Pack

Unecessary Roughness '95,™ Hardball 4,™ FIFA International Soccer, PGA Tour® Golf, NHL® Hockey 95, NASCAR® Racing and a Gravis GamePad. **$99**

Printers

- Epson® Stylus™ Color IIs Ink Jet Printer **$259**
- Hewlett® Packard DeskJet 600C Inkjet Printer **$259**
- Epson Stylus Color II Ink Jet Printer **$339**
- Hewlett Packard LaserJet 5L Printer **$479**
- Hewlett Packard LaserJet 5P Printer **$849**

Service & Support

Gateway Gold™ Premium

- Extended Three-Year On-Site Agreement*
- Priority 800 Number For Access To Technical Experts

$99 w/ system purchase
$129 within current on-site service agreement

**On-site service for desktop and tower systems is available to most U.S. and Canadian locations after determination by a Gateway tech that you need it. On-site service is provided by PC Technology Services Inc. Write or call for a free copy of our on-site service agreement.*

Gateway accepts most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers. You can also apply for the Gateway 2000 DuoLine™ MasterCard® card, issued by Dial National Bank, Des Moines, Iowa.

Ask About Our "90 Days No Payment" Program! NO PAYMENTS

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Call the Gateway 2000 special component add-ons division at 800-846-2080 for our complete line of extras for Gateway customers. Sales Hours: 7am-10pm Weekdays.

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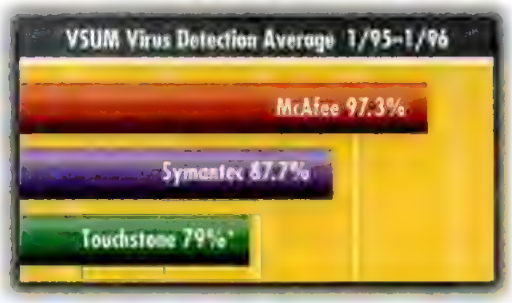
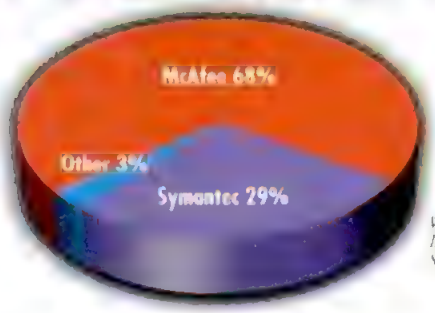


THE NUMBER ONE CHOICE WORLDWIDE.



Worldwide Standalone DOS and Windows Shipments – IDC, 1994

JUST SOMETHING TO THINK ABOUT BEFORE TRUSTING SYMANTEC.

"Symantec's little fib"–Information Week, 9/11/95

A lot of people disagree with Symantec's claim that they have the best virus protection. Even some Symantec people.

Vice President of Desktop Utilities, Ellen Taylor, said "we...regret any misconception..." that resulted from Symantec overstating its detection rate. *Information Week* described it as "Symantec's Little Fib." *The San Jose Mercury News* added that "Symantec, with NCSA's urging, has acknowledged that it may have exaggerated a bit..."

Another Symantec ad misleads readers by comparing their desktop anti-virus product with McAfee's WebScan for the Internet. Advertising aside, just how good is Symantec virus protection? VSUM tests over the past year show that Symantec detected less than 88% of all viruses while McAfee VirusScan caught over 97%.

"Norton's chicken soup not as foolproof as advertised" –San Jose Mercury News, 9/15/95

Maybe that's why McAfee virus protection is trusted by over 10 million users. More than all others. And maybe that's why 80 of the Fortune 100 trust McAfee's products.

To find out for yourself, just download any fully-functioning McAfee product. There are no encryptions or time bombs. We trust you to pay us if you decide to keep it. After all, virus protection is a matter of trust.

And now that you have all the facts, we trust you'll decide on McAfee.

For more information on McAfee products, including our on-line technical support, call **1-888-VIRUS NO** toll free.

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CIRCLE 299 ON READER SERVICE CARD

speed and position, and the editor's Mouse Control menu allowed us to turn the sprite into a dynamic link to other URLs.

Like Macromedia's popular Shockwave, Sizzler works with bitmapped images, but Shockwave has its roots in full-fledged multimedia authoring. Sizzler won't replace these hard-core tools, but the package does make it easy to design animated Web pages that'll keep surfers coming back for more.—*JM*

WEB TRANSLATOR

Like the United Nations, the Web is truly a Tower of Babble. Enter Globalink's Web Translator, an Internet-based translator.

At the click of a button, Web Translator can exchange the text on the active page in your Navigator browser from French, German, or Spanish to English, or vice versa. The full Web Translator costs $49.95, but a version that can translate up to 500 words is downloadable from the company's Web site (*http://www.globalink.com*).

To perform a translation, you open the page you want to read in the Navigator window and then launch Web Translator; unfortunately, you can't open the program from within the browser's window.

Next, click on the Translate button and choose which languages to translate from and to. If you previously translated the page, you can click on Retranslate to update it.

On our tests, it took roughly 1 minute to translate a typical Web page from Spanish to English. This *draft translation* was generally understandable and correct but occasionally produced humorous results: "public service to the Internet. . .arrived to Merida much before what you was imagining." The program was smart enough to transpose nouns and their modifiers, so "Unión Europea" correctly became "European Union." When Web Translator comes across a difficult word, the program wisely either gives the possible options or leaves the word untranslated.

For anyone who's ever wanted to read the headlines from Quito or to learn more about Le Tour de France, Web Translator is a powerful but simple interpreter.—*JM*

WORLDVIEW

Intervista Software's WorldView is a 3-D Web browser for entering and interacting with virtual-reality worlds. Available as a plug-in at the company's Web site (*http://www.intervista.com*), this program has been incorporated into Microsoft's rendering technology, Reality Lab 3D, so it has a good chance of becoming the VRML standard.

You can enter and move around any virtual-reality world with WorldView by using a combination of mouse and toolbar controls. There are buttons for panning, tilting, going to, inspecting, straightening up, and restoring a view. If you hit an HTML link while using WorldView, your chosen browser will pop up alongside the WorldView window.

WorldView, like most virtual-reality browsing technologies, thrives on computing power: Intervista recommends at least a 486DX/50 PC and a 14.4-Kbps modem, but we suggest at least a Pentium system with a 28.8-Kbps modem. WorldView lets you trade image quality for speed. For example, the Good option produces flat shading, which produces rougher shading than the Best option; the Poor option displays wireframe models. The loss in image quality is made up for with increased performance.

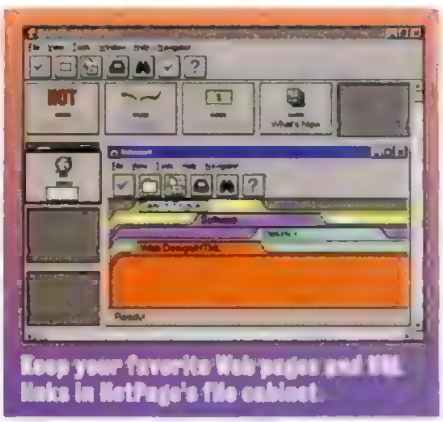
Competition among VRML browsers is running hot. Virtus offers an extremely rich set of worlds that you can view with its browser at *http://www.virtus.com*, but the biggest competition for WorldView will likely come from Microsoft's Virtual Explorer (*http://www.windows.microsoft.com/windows/vrml.html*) and Netscape's WebFX browser (*http://www.paperinc.com/webfxns.html*), which Netscape recently acquired from Paper Software.—*SR*

Keep in mind that these Navigator plug-ins are just the start. Expect to see further integration of databases, multimedia, and 3-D as the Web is fully transformed from a passive to an active viewing medium.

Making Sense of the Web

Document management is firmly entrenched on the desktop but is only starting to have an impact on the Web. Two new products—Iconovex's AnchorPage and DocuMagix's HotPage—that can work alongside Navigator or by themselves show the possibilities.

Iconovex's AnchorPage (*http://www.iconovex.com*), a free download, is targeted at Web users who need to find or create documents relevant to specific interests on the Web but retain the ability to drill-down to desired data within the documents. AnchorPage analyzes a Webserver's database at the rate of about 300 words per minute to create a plain-English indexed synopsis.



Keep your favorite Web pages and URL links in HotPage's file cabinet.

For an example of the potential of this approach, go to Iconovex's Web site (*http://www.iconovex.com/anchor/demos/telcom.htm*) and view a linked version of the recently passed telecommunications bill. Conceptually, this technique is just as valid for working with a corporate intranet consisting of a plethora of legal and technical documents or a government site that includes the legislative and courtroom histories of various laws.

By contrast, DocuMagix's $79 HotPage is an organizational tool that is based on the electronic file cabinet from the company's document management software, PaperMaster. You can arrange the cabinet's drawers in any order, create new drawers, and select titles, icons, and text color for each drawer. Within each drawer, you can create a series of color-coded folders to hold your HotPage documents.

If you find something on the Web you want to keep, HotPage gives you two choices: HotSave saves the item as an HTML document with graphics, formatting, and links preserved. Or HotPrint prints the item as a TIFF image with URL links in the upper-left-hand corner. You can also insert text anywhere on the page or attach an electronic sticky note.

Once you have the files in your HotPage file cabinet, you can attach them to other documents and print, fax, and e-mail them with any MAPI-compliant client. In addition, the ShowText function strips out a document's HTML tags, graphics, and formatting, launches your word processor, and pours the remaining text into a new document. During testing, the program worked well but had trouble dealing with frames; only the active frame was saved to disk.

HotPage's extensive Web document management can turn the Internet into your personal data source, while AnchorPage can make quick work of complex Web sites.—*JM and SR*

Microsoft
WHERE DO YOU WANT TO GO TODAY?

Will the Internet bring an end to business computing as we know it?

Not at all. It will simply knock down the walls between users and the information they need.

What was once thought to be a lofty dream is about to come true: access to any fact or figure, at anytime, from any place. Happily, those who've begun the transition to client-server already have much of what they need in place. And to help businesses incorporate the Internet/intranet into their operations, Microsoft is integrating the necessary technology into many of its products — from desktop to server to tools.

For example, it's never been easier to connect desktops to the Internet. That's because both Microsoft® Windows® 95 and Windows NT® Workstation operating systems have all the "plumbing" built right in. Viewing content is just as effortless. With Microsoft Internet Explorer, users can browse the Internet (or internal corporate webs) whether they're working on the Windows platform or on the Macintosh.™

Of course, making web content easy to view is only the beginning. To be useful to organizations, content has to be easy to create, too. Which is why the latest generation of Microsoft Office applications, along with Internet Assistants, allow users to develop web content without programming. They simply save their work as HTML, the way they would any other document. Such ease-of-use also extends to the newest member of the Microsoft Office family, the Microsoft FrontPage™ web authoring tool, which lets users create and manage entire web sites, even if they've never so much as programmed a VCR.

The Internet is very much a part of our BackOffice™ family, too. With Microsoft Internet Information Server, we've extended the performance of Windows NT Server to make the ideal Internet platform. Now every organization can host and manage web content and applications securely and reliably. And, with Microsoft Exchange Server, secure and reliable e-mail is also a reality, whether it's traveling over the Internet or within your organization.

The truly interactive web page has arrived as well...and with it, full motion video, audio and moving text. Advances made possible by technologies like ActiveX™ controls, which let developers embed sound, video, and applications without having to learn new languages.

Yes, the walls are coming down, but it's not the end of business computing. Just the next, most practical evolution.

To learn more, or to download our free Internet products, visit http://www.microsoft.com/Internet/go11/

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ELECTRONIC COMMERCE

Digital Bucks? Stop Here

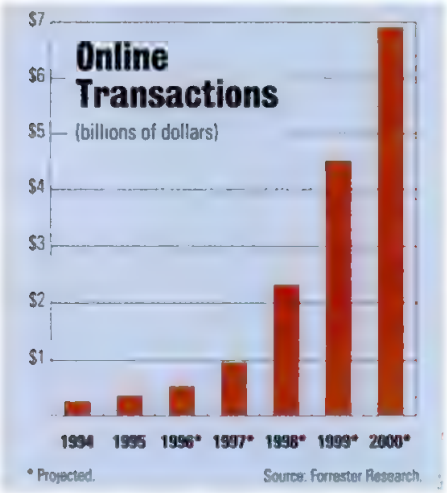
By Sebastian Rupley

As if we needed another way to spend our money. Until recently, commerce on the Web had been more of a rumor than a reality, but now buyers are reaching for their online wallets.

A recent survey of Internet users showed that just 7 percent had ever purchased a product online. But some big names are joining forces to change that.

Buying and selling products online is nothing new. Major commercial services such as America Online, CompuServe, and Prodigy have allowed customers to purchase a wide variety of goods online for years.

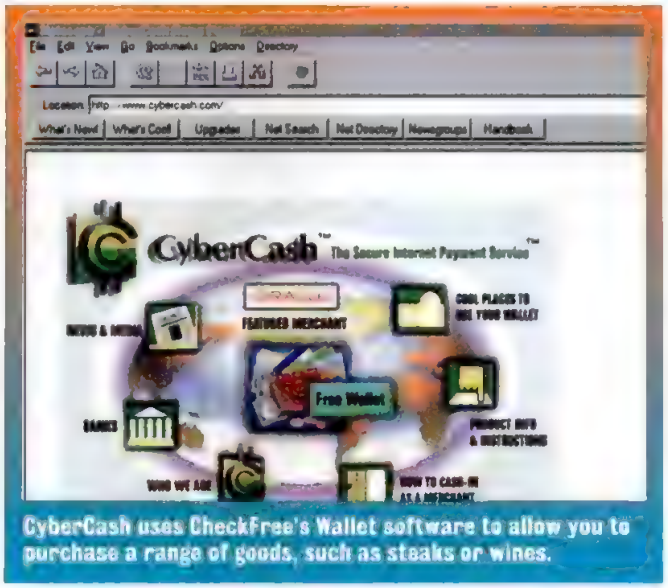
To date, the biggest impediment to Web commerce has been the potential risk of sending your credit card number or other transaction data over an inherently unsecure network. A cadre of powerful companies—IBM, Microsoft, MasterCard, and Visa—are backing a new standard for protecting credit card transactions online, called SET (Secure Electronic Transactions). SET is based on public-key cryptography and electronic certificates issued by credit card companies, which consumers send to merchants to authorize transactions. In addition, Microsoft has announced that a new digital-signature technology that automatically authenticates Internet purchases will be built into Windows.



Aside from security concerns, digital-cash start-ups have also encountered difficulties enlisting a critical mass of merchants and banks willing to support their technologies. The good news is that the infrastructure is now in place for a variety of transactions based on digital cash.

The improved security and growth of the electronic-commerce infrastructure have prompted some rosy projections. According to a recent Forrester Research study on Internet commerce, worldwide revenues from interactive online sales increased from $240 million in 1994 to $350 million last year and could reach $6.9 billion by 2000.

To see just how far Web commerce has come—and in some cases how far it still has to go—we went on a virtual shopping spree. We stopped by some cyberspace malls established by major digital-cash companies and pulled out the online plastic to see how easy it really is to buy goods on the Web with a credit card.



CyberCash uses CheckFree's Wallet software to allow you to purchase a range of goods, such as steaks or wines.

We discovered that Web commerce has come a long way.

CYBERCASH

The leading digital-cash player, CyberCash, is also expected to be the first to cash in on digital commerce. CyberCash, which is partly owned by Softbank (*PC Magazine*'s corporate parent), generates its fees from banks and merchants, not consumers.

At CyberCash (*http://www.cybercash.com*), an online spending spree begins by downloading the Wallet software, which was developed by CheckFree. Once you have a CyberCash account, start looking for Web pages of participating merchants; they display a CyberCash "buy" icon. Just select the goods for purchase, click on the icon to launch CyberCash, and click on the credit card icon. The program sends your CyberCash ID number (which you get when you register), encrypted via RSA's public-key technology, to CyberCash, which decodes it and submits it to a participating bank for authorization.

You can link directly to a variety of shopping sites from CyberCash's home page, including Driesbach's steaks and Virtual Vineyards' California wines. CyberCash provides a streamlined way to spend that makes it almost too easy to buy online.

DIGICASH

Want to add a little international flavor to your online shopping trip? Amsterdam-based DigiCash (*http://www.digicash.com*) is a launching pad to a whole slew of imported online wares.

Unlike CyberCash, DigiCash's ecash isn't a substitute for a credit card at the transaction level. Instead, ecash uses its own virtual currency, represented by on-screen coins and issued by partner banks. The banks are responsible for certifying the authenticity of ecash's virtual coins.

To load your PC with ecash coins, you establish an account with one of the participating banks. The ecash is stored locally on your PC and transferred to the merchant using public-key encryption.

DigiCash's list of participating cybershops is eclectic and at times downright eccentric. Two oddball ways to spend digital cash are the Virtual Beggar, which accepts ecash handouts with a promise to put them to "no good use" (*http://www.gehlken.com/beggar/index.html*) and Instant Gratification Travel (*http://shrine.cyber.ad.jp/~repka/IGTA.html*), which provides slide-show tours of Tokyo for $3.

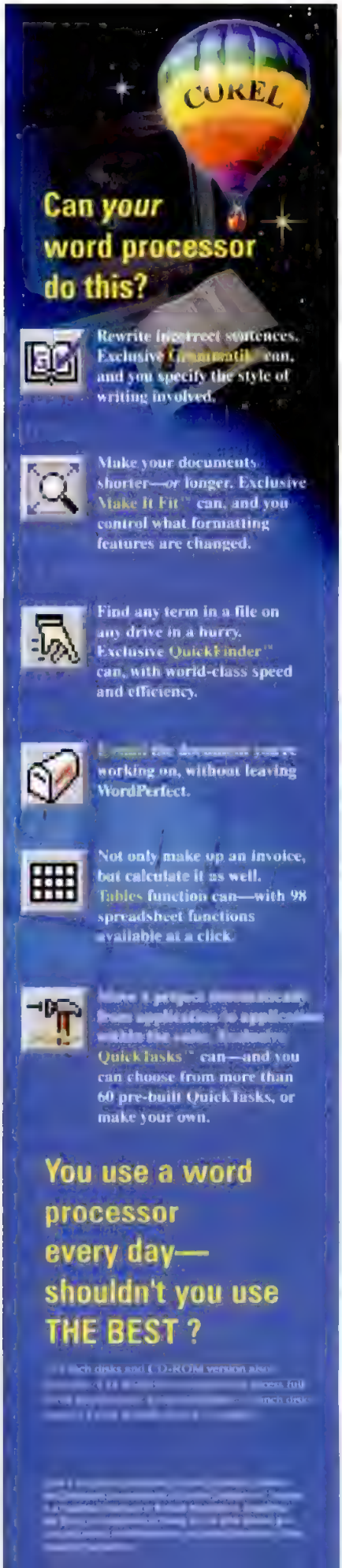
You won't find many durable goods for sale via DigiCash, but fascinating intellectual property and unusual doodads abound.

FIRST VIRTUAL

First Virtual has built a Web shopping scheme around e-mail that bypasses credit card security altogether. The company also offers one of the widest selections of Web-based stores (*http://www.firstvirtual.com*).

The first step is to establish a First Virtual account and get a VirtualPIN ID. This costs $2 and will require the use of a MasterCard or Visa account. After the initial charge, no fees are charged to the buyer other than the cost of the products.

To buy an item with First



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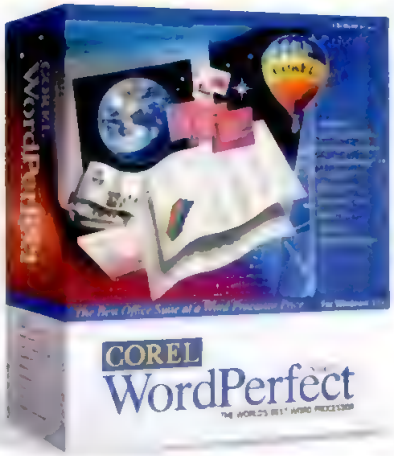

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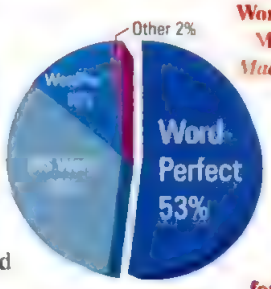
The figures speak for themselves. When people choose a standalone word processor, they choose WordPerfect. In fact, WordPerfect has consistently outsold and outperformed Microsoft Word for Windows 3.1x and Windows 95.



U.S. shipments of standalone word processors, 1995—1.77 million units
Source: Computer Intelligence InfoCorp

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Virtual, you give your VirtualPIN ID to the merchant, which then forwards this and transaction information to First Virtual's payment server. First Virtual then sends e-mail to you requesting approval. Upon approval, your credit card is automatically billed.

Cybertown offers one of the largest selections online but lacks advanced security features.

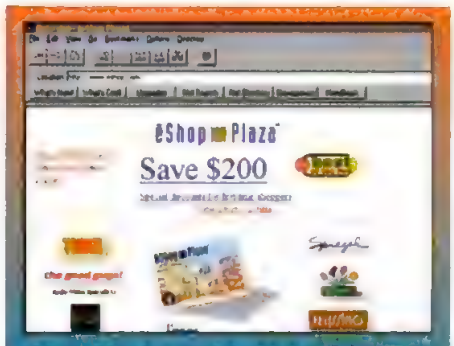
Participating shopping sites are plentiful, and First Virtual's site provides links to them. First Virtual's participating merchants (*http://www.infohaus.com*) are a blend of durable-goods sellers, such as Miracle Boost Jeans, and intellectual-property sellers that offer goods such as a pamphlet entitled "50 Idiot-Proof Ways To Make Money On The Net." You can even buy a car at the site.

First Virtual provides a workable hybrid between pure credit card transactions and digital cash.

CHECKFREE

CheckFree's Wallet software, which you can download at *http://www.checkfree.com*, is a standalone application designed to integrate with Web browsers. The software is included with the Spyglass Mosaic browser and is likely to be used in more Internet payment systems.

CheckFree charges the user a monthly service fee of $5.95 for the first 20 payments and $2.95 for each payment after that. The first time you use CheckFree's Wallet application, you enter a checking account or credit card number and a password. This information is stored in a dual-key RSA-encrypted file on your PC.



eShop Plaza's graphical interface delivers an enjoyable and visual online shopping experience.

The payment data is used to make purchases with participating Web merchants. The merchant then forwards the encrypted information to CheckFree for authentication. CheckFree is responsible for billing either the checking account or the credit card account.

Those wary of electronic card transactions will find CheckFree's service a safe alternative. CheckFree avoids the problem of issuing and trafficking in proprietary digital currency, but it also provides added security over direct online credit card transactions.

We found several interesting shops that use CheckFree's Wallet (*http://www.mc2-csr.com/vmall/checkfree/v20/wmalls.html*), including Media Mart (for CD-ROMs and videos) and Team Sports Wear (for logo-emblazoned T-shirts and sweat suits).

ESHOP PLAZA

eShop Plaza has blossomed into a shining example of the virtual mall (*http://www.eShop.com*). In addition to the original tenants (Good

Continues on page 60

Five Virtual Record Stores

While some people have been waiting for airtight security before they'll buy anything on the Web, the rest of us have been out shopping.

Today on the Web, you can purchase things such as books, flowers, PCs, and music. Lots of music. A recent Yahoo! search turned up no fewer than 277 sites that sell some form of music. The rewards of a Web musical excursion include the ability to search by album title or song title, or even by lyrics. At many sites, you can also sample the music.

Each of these five sites offers secure servers for transmitting confidential data, such as your credit card number, and a variety of search services to find the music you're looking for.

FIREFLY

Firefly *(http://www.ffly.com)* is an innovative site that uses artificial-intelligence technology to analyze your taste in music.

The site's music-ranking system recommends future purchases based on your past selections and on a profile you provide. It's fun to play with and amazingly accurate at guessing what you'll like. It also has the unusual ability to suggest selections that are in stock.

CDNOW

CDnow *(http://www.cdnow.com)* was one of the first music sites on the Web and continues to be one of the most complete and the one that contains the deepest cross-linking.

You can search on an artist and review the resulting list of recordings by date, by title, or by rating. You can read CD reviews as well as a brief biography of the artist. Delivery can be slower than with Firefly, but there are a range of shipping options.

1-800 MUSIC NOW

Though not in the same league as CDnow and Firefly, 1-800 Music Now *(http://www.1-800musicnow.mci.com)* has the best virtual listening rooms. They're easy to navigate, and you can quickly find the right tunes to download. The site also uses cutting-edge technology, such as ShockWave, to enhance your shopping experience.

MUSIC BOULEVARD

Music Boulevard *(http://www.musicblvd.com)* has a wide selection of music and also includes a variety of music publications you can access directly. For example, it's great to read a review of the music in *Spin*, listen to a selection, and then be able to buy the CD. In addition, there are links to e-zines such as @Country, Blues Review, Dirty Linen, e.Bop, Fanfare, Puncture, and more.

CDWORLD

CDworld *(http://www.cdworld.com)* features one of the best and fastest search engines among music sites on the Web. Though it bills itself as the biggest discount-music store and its prices are competitive (though not bargains), the selection isn't as astounding.

Your choice in music is as personal as where you choose to shop for it. Of these five sites, Firefly is the most fun and CDnow has the best selection, but all are worth a peek—and a listen.—*Rick Ayre*

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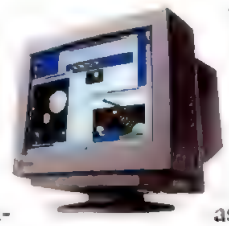

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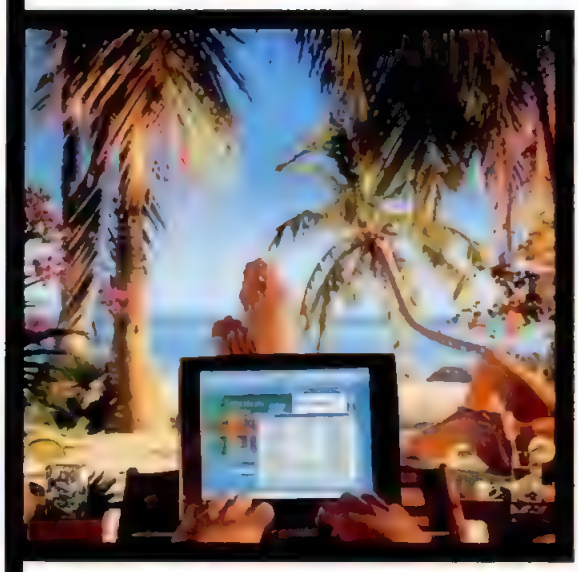
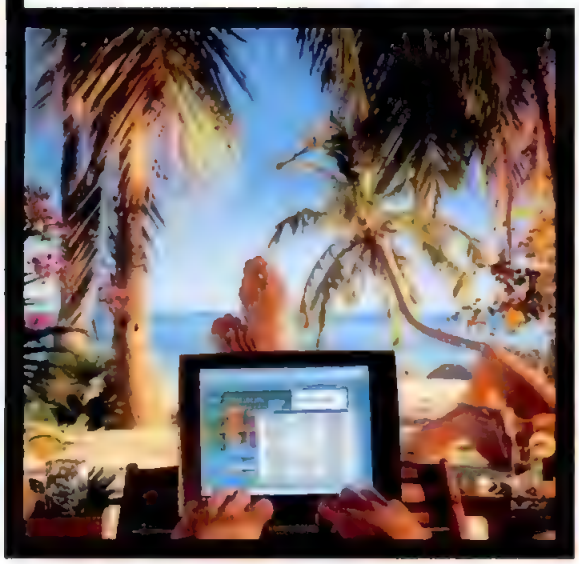


you're always connected *to the* office.

The bad news is,



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CIRCLE 259 ON READER SERVICE CARD

Guys Electronics, Insight Direct, 1-800-Flowers, and Tower Records) you'll find some unexpected extras, such as Felissimo's "exquisite gifts from New York" and Spiegel, the catalog standard.

There are no separate eShop transaction fees, because the mall makes its money from sales commissions. From eShop's home page, you can download free shopping software. The mall and its shops are rich with graphics, right down to a street teeming with virtual shoppers.

The eShop interface goes beyond the static forms-based fare you'll find at most other sites. For example, at Tower Records, there are rows and bins that closely resemble the ones in a real record store.

eShop's mall allows you to purchase and send gifts directly to someone by entering the recipient's address. The mall's shops are big on discounts for first-time users. We saved $2 on a CD at Tower Records, and Spiegel offers 20 percent off your first purchase.

We found eShop's graphically advanced software made online shopping more enticing.

CYBERTOWN

Cybertown is more than just a shopping mall. You'll find food, downloadable software, virtual-reality tours, and much more (*http://www.cybertown.com*).

In addition to the usual merchandise, some offbeat wares you'll find at Cybertown's mall include animal-art sculptures, BMW auto accessories, and boat designs. Cybertown gets its fees from store owners in exchange for allowing them to set up links to its cyberspace mall.

Unlike other electronic-commerce methods, Cybertown does not require a dedicated shopping program. Instead, you establish a Cybertown ATM account. The ATM account affords you "credits" good for a 10 percent discount at Cybertown's stores. You can also choose to buy directly from merchants via encrypted credit card transactions, but you only receive the discount if you use your Cybertown account.

The shopping's easy and the mall is packed with merchants, but you won't find eShop's glitz or the high-tech security at some of the more advanced digital-cash sites. Direct credit card transactions through merchants are the order of the day here.

Cybertown offers one of the best selections available anywhere on the Web. It's a novel way to shop.

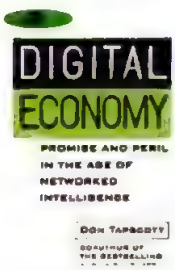
All the Web's a Wallet—Or Soon Will Be

By Sebastian Rupley

With the era of online commerce upon us, the rush is on to implement workable strategies for secure monetary transactions in cyberspace.

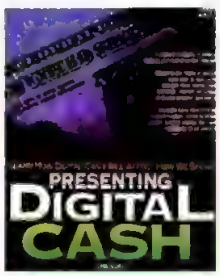
These books, which range in scope from exhaustive technical overview to technology snapshot to historical survey, set out to explain how digital cash works and to cover complicated issues, including security, encryption, economic impacts, standards, and the subtle differences among the players.

From May 13 to 17, you can visit *http://www.zdnet.com/pcmag/discuss.htm* to discuss the theory and practice of digital commerce with the authors.



● *The Digital Economy* ($24.95), by Don Tapscott (coauthor of *Paradigm Shift*), is not intended as an introduction to the technical issues but as a survey of the effect high technology has had on society. In this book, Tapscott does an excellent job of contrasting hide-bound socioeconomic norms with emerging techno-norms. This provocative treatise will please students of the history of technology just as much as it will digital-cash theorists. *http://www.mcgraw-hill.com;* ISBN: 0-07-062200-0.

● *Digital Money, The New Era of Internet Commerce* ($24.95), by Daniel C. Lynch (founder of CyberCash) and Leslie Lundquist, shines in some parts but is not useful for those seeking practical advice. For example, Lynch and Lundquist delve into how democracy and politics may be affected by Internet commerce, but they are short on specifics, lack focus at times, and include incomplete discussions of the primary digital-commerce providers. *http://www.wiley.com;* ISBN: 0-471-14178-X.



● Seth Godin's 250-page *Presenting Digital Cash* ($25) is the most accessible and lucid of the current crop of books on digital cash. Godin has organized the book into sections on technology and on digital-cash providers. The case studies on implementing digital cash and encryption schemes are as interesting as they are telling about the difficulties involved. If you only read one book on digital cash, this should be it. *http://www.mcp.com;* ISBN: 1-57521-062-2.

● If you're planning to set up a commercial Web site, Peter Wayner's *Digital Cash, Commerce on the Net* ($34.95) is a must-read. It provides a guide focusing on making the most of First Virtual's technology. The included 3.5-inch floppy disk is filled with many of the back-end tools you'll need to get started. This book is a treasure trove for anyone who wants to use First Virtual technology to sell on the Web. *http://www.book.uci.edu;* ISBN: 0-12-738763-3.

● *Frontiers of Electronic Commerce* ($49.50), by Ravi Kalakota and Andrew B. Whinston, is a heavily researched analysis of global electronic commerce, from electronic cash to networked databases to firewalls. The authors provide not only one of the most in-depth discussions of intelligent software-commerce agents available; they also look at virtual-reality environments for electronic commerce and at Internet advertising strategies. *http://www.aw.com;* ISBN: 0-201-84520-2.

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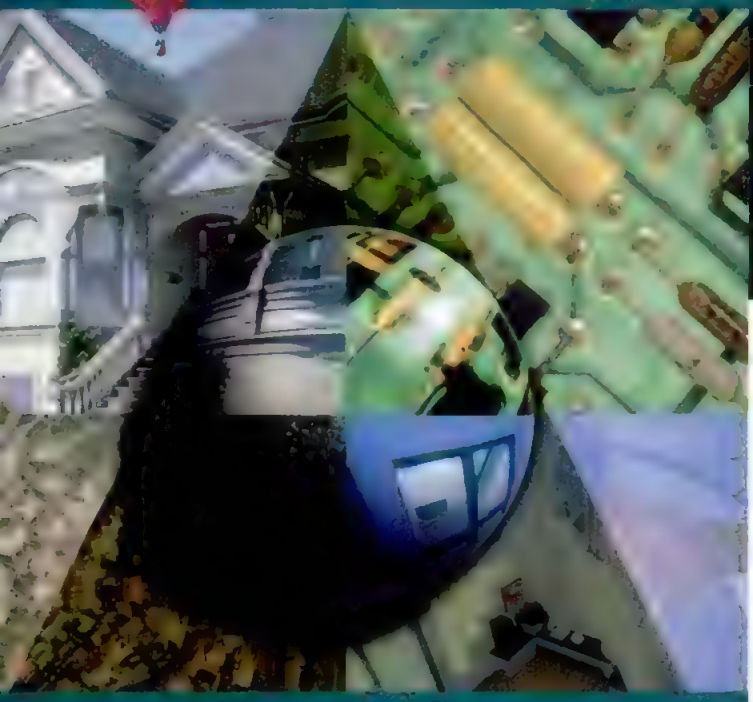

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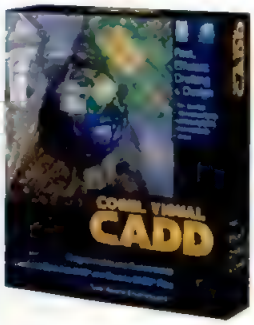

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Multiple Viewports enable you to work on several views within the same drawing file or at different magnifications in several sections of a large complex drawing. Plus, when you exit the file, the multiple viewports you've established will be saved automatically.

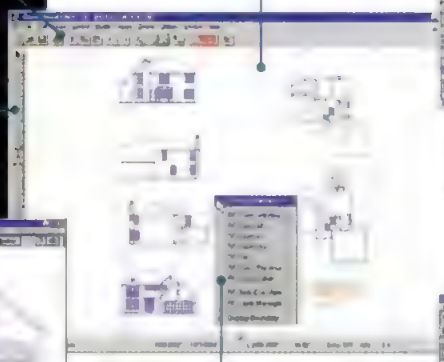
All tool palettes and menu bars are fully customizable.

Quick Commands are logically located on the left-hand palette, so you can access the tool you need with a click of the mouse. Plus, each command has a quick 2-keystroke shortcut to speed the process even further. Spend your time drawing, not searching through tool menus.

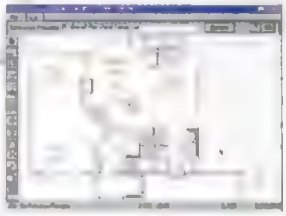
Multiple Dimension Types - Select from ordinate, datum, linear, angular and radial options. Plus, associative dimensions for automatic adjustment of dimension lines.

Bird's-Eye View™ allows you to easily reference specific locations within a drawing with a thumbnail sketch.

Uniquely large, unobstructed drawing areas allow you to clearly view your design



Dynamic Reference Frames give you absolute control over your printing layout by allowing you to reference multiple drawings and or multiple views of the same drawing on your output sheet. You can also seamlessly integrate AutoCAD® xrefs and paper space.



Task Aware Environment™ is able to keep track of where you are in the design process. Since it incorporates enhanced features such as nested commands, matching tools, speed bar dialogs and a context-sensitive right mouse button, you can count on finishing your work in record time.

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CIRCLE 322 ON READER SERVICE CARD

NETWORKED PRINTERS

HP's LaserJet 5: The Leader in Desktop Laser Printers Evolves

By Edward Mendelson

Hewlett-Packard's new HP LaserJet 5 series—the 12-page-per-minute (ppm), 600-dot-per-inch desktop printers that replace the LaserJet 4 Plus series—arrive on the market many months after their close cousins: the slower LaserJet 5L, 5P, and 5MP and the high-speed LaserJet 5Si (First Looks, March 26, 1996). Like their predecessors, these new LaserJets are more evolutionary than revolutionary, but they remain the best printers you can buy in their class.

You can choose from three members of the latest branch of the LaserJet 5 family. The $1,299 LaserJet 5 comes with 4MB of RAM, while the $1,799 LaserJet 5M adds an extra 2MB of RAM, Adobe PostScript Level 2 support, and a network card for Ethernet and LocalTalk. In between is the $1,549 LaserJet 5N (for *network*), a basic 4MB LaserJet 5 that adds Ethernet support but lacks the LaserJet 5M's PostScript and LocalTalk support.

Each of these printers has four SIMM slots for memory expansion; the LaserJet 5 and 5N can hold up to 66MB. The LaserJet 5M's memory capacity is limited to 52MB because of the presence of the PostScript module.

These new printers have a sleeker exterior than earlier models, and there's a button that cleanly and quickly cancels the current print job. Otherwise, the hardware is essentially the same as that of the LaserJet 4 Plus series. The main internal difference is the replacement of the 4 Plus's 25-MHz RISC processor with a 33-MHz chip. The processing speed for complex graphics will increase, but there won't be much practical effect on printing text.

Infrared support for wireless printing isn't built in as it is in the LaserJet 5P, but it can be added through an optional sensor that plugs into the back of the printer. Fonts, forms, signatures, and similar material can be stored on optional flash-memory SIMMs, but you'll have to wait for a new generation of forms and word processing software to take full advantage of this feature.

On the page, the main advance is support for printing a minimum of 256 shades of gray. Below the surface, the major innovation is HP's new printer control language, PCL 6. PCL 6 speeds graphics printing by introducing new imaging "primitives." You can generate a box with rounded corners, for example, with two or three commands instead of about a hundred. This sixth generation of laser-printing commands also provides a closer match between the position of fonts on-screen and on the page (see the sidebar "PCL 6 Produces Graphics Faster").

On PC Labs' tests, the LaserJet 5M came close to its rated output speed, producing 11.2 text pages per minute in both PCL and PostScript mode. Although graphics were impressive, there were some barely noticeable light or dark patches in the output of some bitmapped images—to be expected from this class of printers.

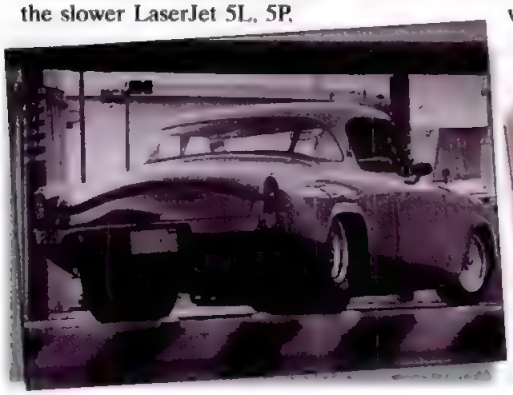
A pair of Windows drivers and a set of DOS drivers come with the printer. Both Windows drivers use the lucid interface familiar from earlier models in the LaserJet 5 series. There's also a Windows driver that provides PCL 5 support, which lets the new printer emulate earlier models.

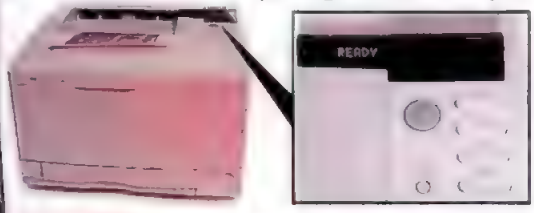
A separate, "enhanced" Windows driver provides PCL 6 support to produce faster graphics and improved screen- and page-matching. Be careful, because the enhanced driver may produce slightly different output compared with that of the basic driver. HP says that the enhanced output is a more accurate representation of what's on the screen.

The enhanced driver doesn't support the Windows 95 Enhanced Metafile (.EMF) format, which is used by most other PCL drivers to enhance spooling efficiency. But HP claims that PCL 6 is so efficient that it doesn't need .EMF support. OS/2 and Windows NT drivers are available from HP's online forums.

The LaserJet 5, 5M, and 5N all have the same 17.4- by 16-inch footprint as the LaserJet 4 Plus

Continues on page 66





LITTLE THINGS: *The HP LaserJet 5M builds on the success of the 4 Plus series and adds important updates, such as a new control panel and rocker switches (inset). Thanks to the use of PCL 6, the HP LaserJet 5M produces complex graphics faster and more accurately.*

PCL 6 Produces Graphics Faster

The latest version of HP's printer control language, PCL 6, is a major step forward in streamlining graphics. It includes three major advances, some of which won't be widely used until new generations of hardware—such as scanners and fax machines—support the new language.

- PCL 6 information streams are device-independent packages of data that can be sent to and from computers, printers, and fax machines. They can consist of anything from a signature or a clip-art image to a whole set of documents. Streams can be stored on flash SIMMs in the LaserJet 5 for faster printing, in the same way that macros can be stored on SIMMs or cartridges under earlier versions of PCL.
- PCL 6 includes an extensive toolbox of graphic objects and operators, including paths, Bezier curves, pens, bitmaps, clipped paths, and rotations and a variety of other transformations. These allow complex images to be generated on the page with compact code instead of the large, simple methods used in earlier versions, bringing PCL closer to the capabilities of PostScript. For example, it takes more than a kilobyte of complex data in PCL 5 to produce a rounded rectangle, while PCL 6 can produce the same object with 19 bytes of code.
- PCL 6 supports the use of a compact synthetic font technology—instead of traditional bitmaps or outlines—to send complex font data with the highest possible efficiency.

Right now, only the latest LaserJet 5 printers support all these features, but you can expect more extensive support across the rest of HP's product line soon.—*EM*

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CIRCLE 122 ON READER SERVICE CARD

HP LaserJet 5M

Continued from page 63

printer, but their 11.8-inch height is slightly shorter compared with the earlier model. Although we like the idea of adding carrying handles to this behemoth of a printer, the sculpted handholds are awkward and at times painful to use, since the LaserJet 5M's 37-pound weight rests entirely on your fingertips.

The printer's main paper tray holds 250 letter- or legal-size sheets; the fold-down front tray holds an additional 100 sheets or 12 envelopes. An optional 500-sheet lower tray costs $299 and fits under the printer. A $679 L-shaped duplexer unit adds a few inches below and behind the printer itself.

NET POSITIVE RESULT

The LaserJet 5M's 16-character LCD screen provides more informative messages than earlier models; the control panel now uses intuitive rocker switches instead of push buttons. A switch for canceling print orders comes in handy, although there's a way for administrators to deactivate the switch so that coworkers won't be able to cancel your print jobs.

Network administrators will appreciate HP's sleek new JetDirect software. They should keep in mind, however, that its queuing algorithm prints all NetWare print jobs before it lets Windows NT jobs get a place in line. The hardware in the LaserJet 5 has proved so reliable that HP now rates it at a duty cycle of 35,000 pages per month—up from 20,000 pages for the 4 Plus.

With assured compatibility with all existing software, the LaserJet 5M is the printer of choice for desktops and small networks.

HP LaserJet 5M. Estimated street price: With 6MB RAM, Adobe PostScript Level 2, $1,799. Requires: PC parallel port, LocalTalk, or Ethernet connection. Hewlett-Packard Co., Direct Marketing Organization, Santa Clara, CA; 800-752-0900. *Circle 417 on reader service card.*

PC CARDS

Megahertz AllPoints Makes The Wireless Connection

By Bruce Brown

Do you need e-mail, data, and fax communication regardless of how far you are from a phone line? Based on the RAM Mobile Data Network, the $499 Megahertz AllPoints Wireless PC Card may be just the tool you need to stay in touch on the road.

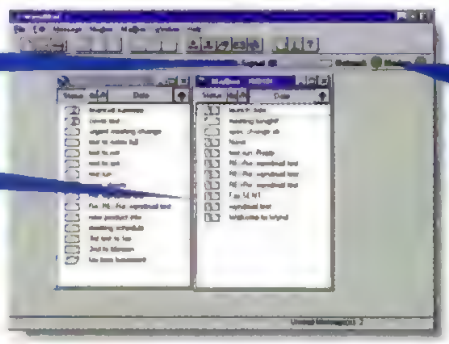
The AllPoints hardware consists of a Type II PC Card that bulges slightly from your notebook to allow room for the card's 9-volt battery and 5-inch retractable and removable antenna. Each card comes with a unique Mobitex number, a 9-volt alkaline battery, and a rechargeable nickel cadmium battery that lasts for 30 hours per charge.

Software for the AllPoints card is available for Windows 3.1, Windows 95, and Macintosh platforms, as well as for a variety of PDAs, such as HP's OmniGo, 100LX, and 200LX and the Apple Newton. The card also comes with Wynd Communications Corp.'s WyndMail and RadioMail, wireless-service providers with individual gateways for one- and two-way communications. Research in Motion's RAD-I/O, a DOS program for transferring files and developing custom communications applications, is also included.

The WyndMail interface is functional and well designed. There are prominent bar graphs for signal strength and battery charge and a pair of connection lights that indicate whether or not you're connected.

During our testing, we found that the system could connect to the radio network with a signal strength as low as 10 percent. With even a minimal signal, the card worked from a moving train and from a variety of stationary locations.

Repeated efforts to use the card underground, from a basement office to a subway, were not successful. But with good connections and using Wynd's gateway, the AllPoints card successfully sent and received e-mail, using Internet addresses, faxes, pages, and text-to-voice messages.



ON-RAMP: *WyndMail's interface makes getting connected with AllPoints easy.*

In many respects, AllPoints is similar to DTS's ZAP-It (First Looks, October 10, 1995). For one, you don't need a computer to get your messages. WyndMail's server uses sophisticated text-to-voice technology to read plain-text messages over the phone. For another, you can't use the PC Card modem to connect to a phone line's RJ-11 connector, so you'll need to carry an extra modem to use land lines.

REACH OUT: *AllPoints lets you use the RAM Mobile Data Network to send and receive messages wirelessly.*

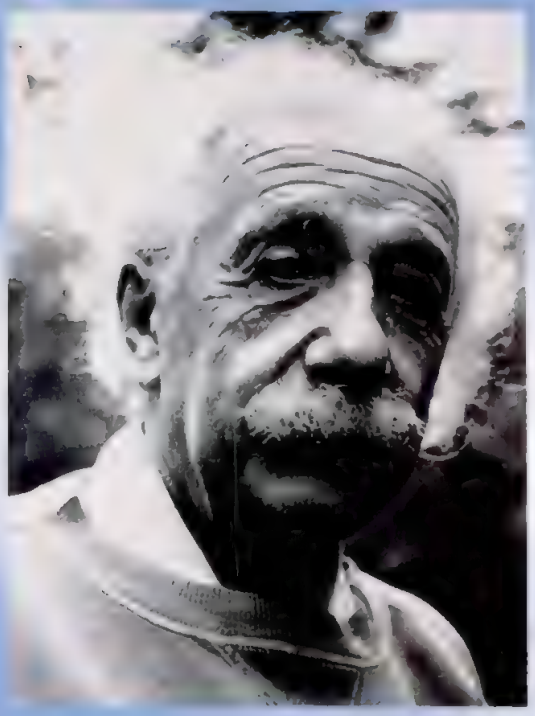
Over a wide variety of operating conditions, we experienced transmission speeds of up to 8,000 bits per second, making AllPoints more appropriate for hit-and-run e-mail communications than for sending long documents, graphics, or multimedia.

When you reach a destination within range of the RAM Mobile Data Network, you simply turn on the computer and start the software. AllPoints automatically does the rest. If the signal is strong enough, AllPoints connects to the network, receives incoming messages, and sends those you've stored for transmission.

There are several service levels available, starting with a $29.95 basic monthly service that includes 200 messages of 150 characters each. Additional messages cost 5 cents per unit, and wireless faxes and text-to-voice messages cost 39 cents each. There's also a service that can store frequently sent faxes in Wynd's server for forwarding to numbers that you specify. We found this was a convenient way to distribute forms, price lists, and other commonly used documents.

In the past, wireless communications seemed to be equal parts cutting-edge technology and magic. Today, however, the Megahertz AllPoints Wireless PC Card is an everyday tool for keeping in touch with your office, wherever you are.

Megahertz AllPoints Wireless PC Card. List price: $499. Requires: 4MB RAM, 1MB hard disk space, Type II PC Card slot, DOS 6.0 or later, OS/2 2.11, Windows 3.1 or later or Windows 95. U.S. Robotics Mobile Communications Corp., Salt Lake City, UT; 800-527-8677, 801-320-7000; http://www.megahertz.com. *Circle 418 on reader service card.*



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Dell's featured computer artist is Marco Marinucci of San Francisco, CA.

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AUTHORING SOFTWARE

Corel CD Creator 2 Turns Your PC into a CD Recording Studio

By James Karney

Corel Corp.'s $249 CD Creator 2 is more than just a cosmetic upgrade of a popular CD-R authoring tool. It is a full 32-bit application that operates under Windows NT and Windows 95, offers improved performance over the original CD Creator (First Looks, March 14, 1995), and supports the newer CD-ROM formats.

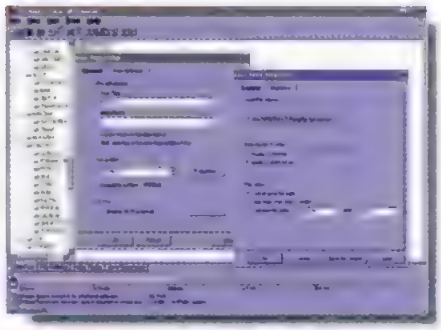
CD Creator 2 has several modules that are accessed from a common interface. Choose the kind of CD you want to make and a wizard offers to walk you through the process. CD Creator 2 supports various file formats, including the traditional ISO 9660 and data standards, as well as long filenames. You can also burn multiple formats, such as Modes 1 and 2, multisession, multivolume, CD Audio, Mixed Mode, Enhanced CD (CD Plus), and Video CD.

Both audio and data files can be added using a Windows Explorer–like interface. As you add files, a status bar displays the space used and the space left on the disk. Exact copies of an existing disk can be made automatically using a duplicator. Once your copy is made, you can use the built-in editor to produce a jewel-case insert with graphics.

Version 1 lacked the ability to create a preview disk image that could be used to simulate performance and to rearrange files. CD Creator 2 makes image files, but it still lacks modeling tools. The program offers a feature that will automatically order files either to improve recording speed or maximize space on the new disk. You can also make a practice run to insure a successful session before writing to the media.

We tested CD Creator 2 on a Pentium/100 PC equipped with 32MB of RAM, a Procom 4X CD-R drive, and a Plextor 6X CD-ROM drive. Installing the software using the setup defaults was effortless. The program identified our CD-R drive and automatically loaded the appropriate driver. Then it tested the hard disk, recorder, and CD-ROM units and set the options for the best recording speed.

We ran several tests under both Windows 95 and Windows NT Server 3.51. Using the duplicator, we created a copy of a 625MB platter in 19 minutes, compared with the 27 minutes required by Version 1. At the 4X recording speed, copying a 74-minute audio disk averaged just over 15 minutes, versus 25 minutes with the older version.



DESKTOP STUDIO: *Corel CD Creator 2 uses a familiar Explorer-like window and supports a range of data formats, including long filenames.*

CD Creator 2's extensive features and ease of use make it a winner for typical business and multimedia tasks.

Corel CD Creator 2. List price: $249. Requires: 20MB RAM (for Microsoft Windows NT 3.51) or 8MB RAM (for Windows 95), 6MB hard disk space, CD-ROM drive. Corel Corp., Toronto, Ontario, Canada; 800-772-6735, 613-728-3733; fax, 613-728-9790. *Circle 421 on reader service card.*

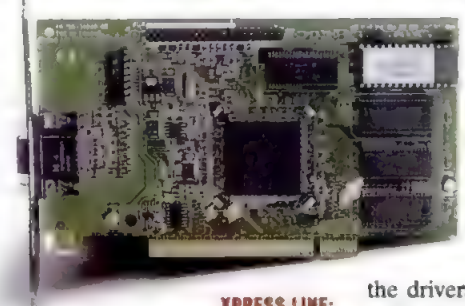
GRAPHICS ACCELERATORS

ATI Video Xpression: Solid Graphics and Smooth Video

By Jonathan Hill

The $239 ATI Video Xpression, a DRAM-based graphics card, delivers reasonable graphics performance and much-improved video playback at a hard-to-beat price.

The Video Xpression is the first in a series of multimedia cards based on the ATI-264VT Mach64 accelerator chip, and its separate vertical and horizontal line buffers give the Video Xpression the ability to scale the viewing window horizontally and vertically. Other similarly priced video accelerators generally interpolate in one direction and replicate pixels in the other, resulting in artifacts.



XPRESS LINE: *The ATI Video Xpression delivers excellent video and strong 8- and 16-bit graphics.*

Video-playback quality is noticeably improved over previous generations of ATI accelerators, although the card's 2-tap filter does cause some ghosting when scaling video with abrupt color changes.

The Video Xpression comes with a nearly complete set of DirectX drivers for Windows 95 (Microsoft's extensions for Direct3D and DirectVideo weren't ready for testing). The board's Windows 95 support is nicely implemented via folder tabs accessible from the Display Properties dialog box.

When you install the drivers, you can also install ATI's MPEG playback software, which takes advantage of the ATI-264VT's ability to handle MPEG in its native YUV412 format. We were impressed by the smooth, clean video playback, but the audio portion was roughly akin to the sound produced by an AM radio. MPEG Theatre, a hardware MPEG-decoder add-on due to be released this spring, will provide higher frame rates, resolutions of up to 1,280 by 1,024 pixels, and full CD-quality stereo audio; there will also be a TV Tuner add-on.

To evaluate the Video Xpression's graphics and video performance under Windows 95, we used WinBench 96 and the testbed from "Display Mates," December 5, 1995. At a resolution of 800-by-600, the board produced Graphics WinMark 96 scores of 9.4 million pixels per second in true-color (32-bit) mode and an impressive 25 million pixels per second in 8-bit color mode. In true-color graphics mode, the Video Xpression delivered modest video-playback performance at the price of high CPU utilization and a large number of dropped frames.

When we switched to 256-color mode, the board's maximum frame rate jumped from 10.8 frames per second (fps) to 85.8 fps; CPU utilization dropped 50 percent, and no frames were dropped.

The ATI Video Xpression won't satisfy dedicated graphics professionals, because it can hold only 2MB of DRAM, which limits true-color graphics. But most users will find the board's low cost, excellent video quality, and nearly complete selection of drivers a compelling mix.

ATI Video Xpression. List price: $239. Requires: PC with PCI slot, 4MB RAM, Microsoft Windows 3.1, Windows 95, or Windows NT. ATI Technologies Inc., Toronto, Ontario, Canada; 905-882-2626; http://www.atitech.ca. *Circle 422 on reader service card.*

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Despite popular belief, Windows 95 applications aren't very thorough at automatically removing themselves from your hard drive. Regardless of which version of Windows you use, you need UnInstaller to continually clean things up. UnInstaller Works with both 16-bit and 32-bit applications.

It's what you don't see on your hard drive that causes problems. Every application puts bits and pieces of itself in places you don't know about. Without UnInstaller, things can slow down — or come to a screeching halt.

And, as an added safety net, UnInstaller automatically compresses and backs-up everything it removes. So, as you clean off bits and pieces of old files, you can take comfort in being able to put things back exactly as they were with the simple click of a button.

Of course, with other deletion programs you can have the experience of getting rid of things you never meant to get rid of. Which may be good for us, but bad for you.

Why take your chances with just any old clean-up program? UnInstaller is the No. 1-selling Windows utility on the market with more than a million copies sold.

1-800-922-3383

Available at your local software store. MicroHelp is at www.microhelp.com

CIRCLE 214 ON READER SERVICE CARD

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MicroHelp

HEY, EVERYONE CAN USE A LITTLE HELP.

Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

By Brian Nadel

NOTEBOOKS

ThinkPad 760CD's Long Journey To Windows 95

WHEN WE REVIEWED THE IBM ThinkPad 760CD, we were impressed by this notebook's ability to fit all the necessary elements of a high-performance desktop PC into a briefcase (First Looks, November 21, 1995). From its internal 4X CD-ROM to its vivid 12.1-inch Super VGA display, the ThinkPad 760CD seemed to have all the pieces in place. All but one, that is, because the first notebooks came equipped with both Windows 3.1 and OS/2 Warp but not Windows 95. And those who have attempted to upgrade to Windows 95 have found it a Sisyphean task.

Finally, relief has arrived—sort of. Migrating to Windows 95 starts with reformatting the system's hard disk, so you should back up the files you want to keep. Once the hard disk is clean, you'll need to upgrade the notebook's flash BIOS to a Windows 95–friendly file, available in the ThinkPad section of IBM's Web site (*http://www.ibm.com*). While you're at the site, you'll also want to download the latest video and sound drivers, so you can get the most from your notebook.

The last step of this arduous task is to install Windows 95 from the CD-ROM and either restore your system's contents from the backup you made or rebuild your system from scratch. This drawn-out process left at least one user wondering whether the cure was worse than the disease.

OS/2 PROGRAMS

Rhintek Fills in the Blanks

WHEN IT COMES TO COMMUnications programs that run natively in OS/2, the choices are few and far between. So when Rhintek released its modem software, RhinoCom 1.0, last year, we recommended the package, despite the lack of support for host mode and the CompuServe B and Kermit protocols (First Looks, March 28, 1995).

Rhintek listened and has revamped RhinoCom to address these shortcomings and expand the program's scope. Version 1.5 adds support for DigiBoard cards that can accommodate multiple phone lines. And though the program's scripting still relies on IBM's arcane REXX language, Rhintek has added a wizardlike series of dialog boxes that will be helpful to casual users without alienating longtime OS/2 users. REXX aficionados will continue to love the power and the flexibility of the language.

The Standard version costs $199, and registered users will receive the upgrade free through the mail. A Home version without host mode is also available for $99. If you're one of the many buyers who never fill out registration cards, call Rhintek at 410-730-2575 to get the upgrade.

BUG BRIEFS

PROBLEM

Remove-It, Version 3.0 for Windows 95, refuses to load on PCs that are connected to a Windows NT–based network.

SOLUTION

Version 3.02 fixes a NUL pointer bug in the uninstaller program, allowing Remove-It and Windows NT to coexist. The patch is available at http://www.vertisoftsys.com *or at Vertisoft's CompuServe forum.*

PROBLEM

If you've suffered from corrupted data or dropped connections while online, the fault may be with your modem because of a flaw in Rockwell's RPI chip set, which is used in many budget modems.

SOLUTION

Try lowering your transmission speed to 9,600 bps and going to Rockwell Semiconductor Systems' Web page (http://www.rockwell.com) *to get detailed instructions for a workaround.*

UPGRADE CPUs

Underwhelmed About OverDrive

FOR A TIME, ONE IN FOUR letters in the Second Looks mailbag came from disgruntled owners of early Gateway 486 PCs who had discovered that their systems couldn't be upgraded with Intel's OverDrive processor. With files supplied by Gateway, many systems can now use 63-MHz or 83-MHz OverDrive CPUs, albeit at a cost some will find too high.

The problem was that these 486 systems were designed from early specifications for the OverDrive processor. The fix shouldn't take more than about 10 minutes. Start by updating the system's BIOS with P4D4047.EXE, available from Gateway's electronic bulletin board (800-846-7562). Then plug in the new CPU.

Though this is a step in the right direction for Gateway PC users, for now they'll have to sacrifice use of the system's external cache in order to use the OverDrive CPU. Gateway promises a further update that will allow the use of cache, so keep an eye on the company's BBS. Until then, you'll have to trade cache for a faster processor.

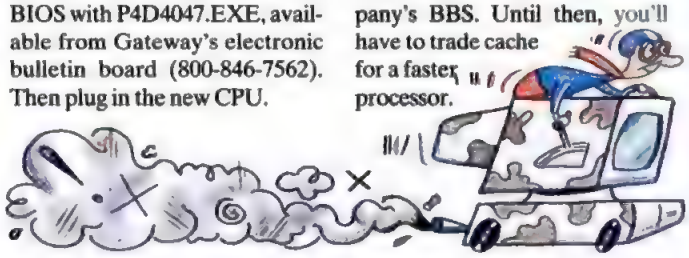


ILLUSTRATION BY M.E. COHEN

LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues. • ClarisWorks 4.0 • Color ink jet printers • EZ-SCSI 4.0 • 4X CD-ROM drives • Home PCs • Lotus Notes, Release 4 • Microsoft Internet Explorer • Netscape Navigator 2.0 • PartitionMagic • Pentium Pro PCs • SoftWindows • Windows 95 utilities. Contact Brian Nadel directly via MCI Mail (556-1500) or CompuServe (72241,1616), or on the Internet at *bnadel@zd.com*.

DO NOT BITE THIS MONITOR.

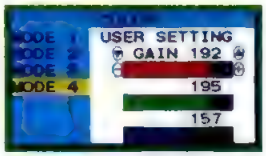
WARNING: The images you see on the new CTX PR900™ Professional Line Monitors are not real.

We say this because artists, graphic designers, and CAD/CAM users everywhere keep mistaking the PR900's sharp, distortion-free images for the objects they represent.

Maybe it's because the 21-inch PR900 offers the crispness of Diamondtron™ technology. With a colossal 19.6-inch viewable screen area and 0.31-mm aperture grille for uncommon contrast.

Or perhaps it's the PR900's 1600 x 1200 maximum resolution. And anti-glare, anti-static, anti-reflection screen. With vibrant colors that make other monitors pale in comparison.

In any case, with features like Windows® 95 Plug & Play, TCO '92 Certification, and Power Management—plus PC, Mac & SPARC compatibility—the PR900 is an unreal buy. Especially since it costs hundreds less than any monitor in its class.



The on-screen display (OSD) features over 30 user-friendly functions—for the most intricate adjustments.

Since seeing is believing, we invite you to visit your nearest CTX dealer. Just call **1-800-888-9052** or visit our web site at **www.ctxintl.com.** But remember—just look, don't bite.

CTX

Commitment To Excellence.

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See the new CTX PR900 at PC Expo, Booth #4562.

CIRCLE 329 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Melissa J. Perenson

Cutting-Edge Digital Camera

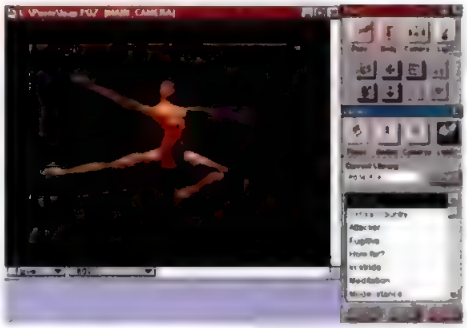
WITH THE DIGITAL-IMAGING REVOLUTION IN FULL SWING, Sony Electronics' $2,000 **Sony DKC-ID1** provides the kind of creative and technical control that's usually left to the expertise of SLRs and other, more sophisticated cameras. The DKC-ID1 lets you capture vibrant JPEG images without limiting you to particular lighting conditions or focal distances. The compact, 26-ounce camera has a 450,000-pixel progressive-scan charge-coupled device (CCD) that gives you 768- by 576-dot-per-inch (dpi) resolution. A convenient color LCD viewfinder helps you accurately frame a subject as well as instantly review a captured image. The camera has a 12X zoom lens (the equivalent of a 38-460-mm zoom lens on a 35-mm camera), a built-in flash, and both manual and automatic focus, shutter speed, and exposure settings.

Sony's camera capitalizes on the company's existing technologies. You can archive images to Sony's MDH-10 portable MiniDisc data drive and store up to 1,000 digital images on a single MiniDisc. Also, the camera uses the same rechargeable lithium ion batteries as Sony's Handycam camcorders.

Sony Electronics Inc., Montvale, NJ; 800-472-7669; http://www.sel.sony.com/sel/bppg/epp/index.html. *Circle 403 on reader service card.*

Strike a Pose

FORGET ABOUT DRAWING stick figures. Now, anyone—even the artistically challenged—can create realistic-looking human forms with Fractal Design Corp.'s **Fractal Design Poser.**



Priced at $199 ($99 through the end of May), Poser is a unique and innovative Windows 95 design tool for modeling and rendering the human form. Poser understands the intricacies of the human body, and as a result, you can easily create an infinite variety of figures by dragging various body parts until you've manipulated and contorted them into the desired positions. You can choose from a selection of male and female body types and sizes.

When you've finished shaping your figure, you can add light sources and texture maps to create a fully rendered model of the human body. Designed for use with 2-D and 3-D design packages, you can export your final image as a .BMP, .DXF, .RIB, or TIFF file.

Fractal Design Corp., Aptos, CA; 800-297-2665, 408-688-5300; http://www.fractal.com. *Circle 401 on reader service card.*

Mouse Control

A MOUSE IS NO LONGER just a mouse. Logitech's $60 **MouseMan 96** takes the company's familiar three-button programmable MouseMan mouse and couples it with Logitech's HyperJump software, which offers Windows 95 navigational shortcuts. The useful shortcuts provide access to eight of the most frequently invoked Windows 95 commands—including Start, TaskBar, vertical and horizontal scrolling, and minimizing, resizing, and closing your current window—all with a single click of the mouse's center button.

Logitech Inc., Fremont, CA; 800-231-7717, 510-795-8500; fax, 510-792-8901. *Circle 404 on reader service card.*

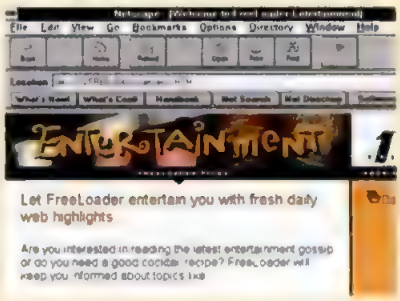
PHOTOGRAPHY BY THOM O'CONNOR

HOT PROSPECT

Desktop Delivery of Web Pages

Off-line delivery of World Wide Web pages is the latest rage, which should not be surprising: Time you spend online is money out of your pocket. Besides, we're used to having our news and entertainment delivered directly to us, as opposed to having to go out and seek updates on our own. **FreeLoader** is attempting to change the way we use the Web with browser-helper applications.

FreeLoader's menu integrates itself with your browser, providing a FreeLoader toolbar for navigating around your selections. FreeLoader, which has been licensed for distribution by several popular Web sites, lets you visit a Web site and then subscribe to that Web site for future updates. The FreeLoader background engine will download the Web page and however many links from that page as you specify while you're still surfing the Web. FreeLoader reproduces the Web page locally, automatically rebuilding the page's graphics and hypertext links on your local machine.



FreeLoader Inc., Washington, D.C.; 202-686-0660; http://www.freeloader.net. *Circle 419 on reader service card*

Selling the Smart Way

TELEMAGIC'S SALES-AUTOmation and contact management software, **TeleMagic Professional for Windows, Version 2.0,** is a $249.95 package that addresses the needs of sales professionals by providing such standard features as an internal e-mail system, database synchronization, and an activity link to contacts.

Wireless messaging is now available across TeleMagic's contact records, activity records, and e-mail. The new version also features enhanced faxing, fields for Internet access, and improved links with popular billing and accounting software.

TeleMagic Inc., Dallas, TX; 800-835-6244, 214-733-4292; fax, 214-930-8873. *Circle 402 on reader service card.*

Surfing the Net for Free

WHO SAYS THERE'S NO SUCH thing as a free ride? Evidently not AT&T Corp. The telecommunications giant enters the Internet

service provider market with its **AT&T WorldNet Service.** AT&T long-distance customers receive 5 free hours of Internet usage per month for a year. Each additional hour costs $2.50, or customers can opt for a $19.95 monthly flat fee for unlimited use. Noncustomers can pay $4.95 for the first 5 hours or $24.95 for unlimited usage. The service uses an AT&T-branded version of Netscape Communications Corp.'s Netscape Navigator Personal Edition, Version 1.22.

MCI Communications Corp. is targeting consumers with reduced fees for its **InternetMCI** service. MCI long-distance customers who sign up by the end of May will get 5 hours of free Internet service per month for a year, or unlimited monthly access for $19.95. Noncustomers pay $5.95 for the first 3 hours or $24.95 for 20 hours per month; extra hours cost $2.50 each.

AT&T Corp., Basking Ridge, NJ; 800-967-5363; http://www.att.com/worldnet. *Circle 411 on reader service card.*

MCI Communications Corp., Washington, D.C.; 800-550-0927; http://www.mci.com. *Circle 412 on reader service card.*

A Modem Just for Windows

DOS AND OS/2 USERS NEED NOT APPLY: U.S. ROBOTICS' $150 **Sportster Winmodem** is a 28.8-Kbps fax modem designed for use strictly with PCs running Windows. This internal V.34 modem has a Texas Instruments DSP on-board, with a U.S. Robotics modem-code memory sitting on your drive instead of on the modem board itself. Therefore, the modem's flash BIOS is easily upgradable via software. The modem is upgradable to 33.6 Kbps, which is currently the fastest modem transmission speed available. U.S. Robotics' Connections CD-ROM, which includes Internet access and communications software, is bundled with the Winmodem.

U.S. Robotics, Skokie, IL; 800-342-5877; fax, 847-676-7320; http://www.usr.com. *Circle 408 on reader service card.*

Feature-Rich PCs for the Home

IT'S A NEVER-ENDING PARADE OF PCs TARGETED AT THE home market.

Hewlett-Packard Co.'s **HP Pavilion 7100** series comes standard with 16MB of RAM, a 17-inch monitor, a 6X CD-ROM, 3-D Spatializer sound, and a 28.8-Kbps modem; available processors run the gamut from 120- to 166-MHz Pentiums, while hard disks range in size from 1.26GB to 2GB. HP also offers innovative options: The $2,350 7110Z comes with a 120-MHz CPU, a 1.26GB hard disk, and a built-in Iomega Zip drive; the $2,649 7130P comes with a 133-MHz CPU, a 1.62GB hard disk, and a built-in color snapshot scanner.

NEC Technologies has six new models of its **Ready** family and home-office PCs. These systems, which range in price from $1,699 to $2,799 and in processor type from Pentium/120 to Pentium/166, come with hard disk capacities of 1.2GB to 2GB, 6X CD-ROM drives, telephony functionality, SRS 3-D surround sound, remote control for the answering machine and CD player, and an IrDA port. The $2,199 **Ready 9617** includes a 133-MHz Pentium CPU, 16MB of RAM, a 1.6GB hard disk, 1MB of VRAM, and a 28.8-Kbps data/fax/voice modem.

NEW DESIGN: *Packard-Bell's Platinum series.*

Packard-Bell's **Platinum** and **Platinum Pro** series of PCs also brings high-end power to home users. All systems have 150-MHz or 166-MHz Pentium CPUs, 1.6GB or 2GB (Platinum Pro only) hard disks, 16MB or 24MB (Platinum Pro only) of RAM, a 6X CD-ROM drive, SRS 3-D surround sound, telephony, a 28.8-Kbps fax modem, and a remote control. Prices start at $1,999 for a 133-MHz Platinum system.

Hewlett-Packard Co., Santa Clara, CA; 800-724-6631; http://www.hp.com. *Circle 414 on reader service card.*

NEC Technologies Inc., Boxborough, MA; 800-632-4630, 508-264-8000; http://www.nec.com. *Circle 415 on reader service card.*

Packard-Bell Electronics Inc., Sacramento, CA; 800-733-5858, 916-388-0101; http://www.packardbell.com. *Circle 416 on reader service card.*

BRIEFS

Books

Where did Berkeley Systems get the idea for its flying-toasters screen saver? **The Official Computer Bowl Trivia Book,** by Christopher Morgan, is chock-full of such tantalizing minutia culled from the computing world. The answer, by the way, is from the cover of a Jefferson Airplane album ($10, Crown Books, 800-733-3000) .... **The Internet Report** is a detailed analysis of the business side of the Net written by a team of analysts at Morgan Stanley. It includes Morgan Stanley's list of Cool Web sites, complete with pictures of the home pages ($20, HarperBusiness, 800-331-3761) .... For those less technically inclined, **Site Seeing the Internet,** by educators Suzanne McDonough and Gary Garfield, is a gentle introduction to the World Wide Web. The book, which is geared toward parents, teachers, and children, includes reviews of 200 interesting sites ($16, Peguis Publishers, 800-667-9673).

Hardware

I.R.I.S. America's $399 **IRISPen Executive** is an upgrade to I.R.I.S.'s data pen, which is used for scanning individual lines of text. The new software can read bar codes and incorporates text-to-speech capabilities for reading 26 languages and white-on-black text (800-447-4744) .... If you want a monitor that's somewhat closer in price to a 17-inch monitor but somewhat closer in size to a 21-inch monitor, try Sampo Technology's $995 20-inch **AlphaScan GL.** The streamlined monitor uses a Mitsubishi CRT, has a 0.31-mm dot pitch, and features a horizontal sync rate of 30 to 65 kHz and a vertical refresh rate of 50 to 90 Hz (770-449-6220).

120MHZ PENTIUM® CHIP, TFT, 16MB, LITHIUM, $3199.

WinBook XP5

"Fastest notebook yet...."
—*PC World*, April 1996

5 OUT OF 5 WINDOWS MAGAZINE'S HIGHEST RATING

"...the best design of any notebook I've tested."
—Michelle A. Tyrrell, *Windows Magazine*, March 1996

intel inside pentium PROCESSOR

$2399

WINBOOK XP5 75MHz

- 75MHz INTEL PENTIUM® PROCESSOR — POWER-SAVING NOTEBOOK CHIP
- 8MB RAM
- 540MB REMOVABLE HDD
- 256K L2 CACHE
- 14.4 SEND/RECEIVE FAX/VOICE/DATA MODEM
- 10.4" TFT ACTIVE MATRIX COLOR DISPLAY
- 3.5" 1.44MB DISKETTE DRIVE
- 6.1 POUNDS
- 32-BIT LOCAL-BUS VIDEO
- NIMH BATTERY W/ POWER MANAGEMENT
- 1MB VIDEO RAM
- TWO TYPE II OR ONE TYPE III PCMCIA SLOT
- INTEGRATED DUAL-BUTTON POINTING STICK, OPTIONAL DUAL-BUTTON TRACKBALL OR TOUCHPAD
- PARALLEL, SERIAL AND PS/2 PORTS

Double your RAM to 16MB for only $399 at time of notebook purchase!

$2999

WINBOOK XP5 75MHz

- 75MHz INTEL PENTIUM® PROCESSOR — POWER-SAVING NOTEBOOK CHIP
- 16MB RAM
- 810MB REMOVABLE HDD
- 256K L2 CACHE
- 14.4 SEND/RECEIVE FAX/VOICE/DATA MODEM
- 10.4" TFT ACTIVE MATRIX COLOR DISPLAY
- 3.5" 1.44MB DISKETTE DRIVE
- 6.1 POUNDS
- 32-BIT LOCAL-BUS VIDEO
- 40 WATT LITHIUM ION BATTERY W/ POWER MANAGEMENT
- 1MB VIDEO RAM
- TWO TYPE II OR ONE TYPE III PCMCIA SLOT
- INTEGRATED DUAL-BUTTON POINTING STICK, OPTIONAL DUAL-BUTTON TRACKBALL OR TOUCHPAD
- PARALLEL, SERIAL AND PS/2 PORTS

Add stereo sound for only $79.95!

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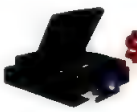
WINBOOK XP5 120MHz

- 120MHz INTEL PENTIUM® PROCESSOR — POWER-SAVING NOTEBOOK CHIP
- 16MB RAM
- 810MB REMOVABLE HDD
- 256K L2 CACHE
- 14.4 SEND/RECEIVE FAX/VOICE/DATA MODEM
- 10.4" TFT ACTIVE MATRIX COLOR DISPLAY
- 3.5" 1.44MB DISKETTE DRIVE
- 6.1 POUNDS
- 32-BIT LOCAL-BUS VIDEO
- 40 WATT LITHIUM ION BATTERY W/ POWER MANAGEMENT
- 1MB VIDEO RAM
- TWO TYPE II OR ONE TYPE III PCMCIA SLOT
- INTEGRATED DUAL-BUTTON POINTING STICK, OPTIONAL DUAL-BUTTON TRACKBALL OR TOUCHPAD
- PARALLEL, SERIAL AND PS/2 PORTS

Add Syncburst cache and 1.3GB HD, $300!



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- 10.3" DUAL-SCAN COLOR DISPLAY

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WINBOOK XP 100MHz

- 100MHz INTEL® 486 PROCESSOR
- 16MB RAM
- 810MB REMOVABLE HDD
- 14.4 SEND/RECEIVE FAX/VOICE/DATA MODEM
- 10.3" DUAL-SCAN COLOR DISPLAY

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CIRCLE 085 ON READER SERVICE CARD

Designed for Microsoft Windows 95

intel inside pentium

Leading Pentium processor/PCI performance at an affordable price.

- Intel 75, 90, 100, 120 or 133 MHz Pentium processors
- Desktop and minitower packages
- 256KB cache
- 8-16MB RAM, expandable to 128 or 192MB
- EDO RAM on some models
- PCI/ISA architecture
- 420MB** high-performance Enhanced-IDE hard drive
- PCI integrated graphics accelerator and 1MB of VRAM standard, upgradable to 2MB or Matrox Millenium PCI graphics card with 3D acceleration and 2MB of WRAM, upgradable to 4MB
- Flash BIOS for easy upgrade
- Full plug-and-play capability
- Designed for Windows 95
- Preloaded HP DMI250 Desktop Management Interface
- Free three-year limited warranty for parts and labor[1]

from $1,469*

HP Vectra VL

Redefining network-ready PCs for the workgroup.

- Intel 75, 90, 120 or 133 MHz Pentium processors
- Leading Remote Management (HP DMI250) preinstalled
- PCI integrated 32-bit 10baseT Ethernet interface
- Network certified and preconfigured for Microsoft and Novell clients
- Parallel Transfer Driver preinstalled for faster LAN packet processing
- Standard 256KB second level cache
- 64-bit graphics accelerator (Cirrus Logic 5434) on PCI bus
- 1MB of video RAM standard, expandable to 2MB
- 8MB RAM, expandable to 192MB
- Enhanced-IDE controller on PCI bus
- 420MB** high-performance Enhanced-IDE hard drive
- 4 mass storage shelves (3 front accessible), 4 expansion slots
- Two 32-bit PCI slots
- Flash BIOS for easy upgrade
- Designed for Windows 95
- Free three-year limited warranty for parts and labor[1]

from $1,539*

HP Vectra XM

The ultimate PC for advanced business and technical applications.

- Intel 120 or 133 MHz Pentium processors
- Supports dual processing with secondary processor socket
- 512KB second level burst synchronous write-back cache
- Two 32-bit PCI slots, 1 PCI/ISA combo slot, 1 ISA slot
- 1,000MB** high-performance Enhanced-IDE hard drive
- Integrated 32-bit PCI Fast SCSI-2 and Enhanced-IDE interfaces
- Integrated PCI Matrox Millenium graphics card with up to 1600 x 1200 resolution
- 16MB of RAM standard, expandable to 256MB
- Integrated PCI 32-bit 10BaseT and Coax network interface
- Preloaded Desktop Management Interface (DMI)
- Free three-year limited warranty for parts and labor[1]

from $3,389*

HP Vectra XU

In Canada call 1-800-387-3867. *Average U.S. street price. Monitor not included. **Other capacities available. HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 or Windows 95 or Windows NT included. First year on-site 24-hour next-day service. Second and third year return to dealer. MS-DOS is a U.S. registered trademark and Windows and Windows NT are U.S. trademarks of Microsoft Corporation. Pentium and the Intel Inside logo are U.S. registered trademarks of Intel Corporation. OS/2 is a registered trademark of the International Business Machines Corporation. © 1995 Hewlett-Packard Company. PPG425

The fastest PC available.

- Intel Pentium Pro 150 MHz processor with 256KB integrated cache
- Supports dual processing with secondary Pentium Pro processor socket
- 128-bit high performance memory architecture
- 16MB of ECC DIMM memory standard, expandable to 256MB with 8 DIMM memory expansion sockets
- PCI integrated Ultra SCSI Fast 20 interface with 20MB/s throughput
- 1,000MB** SCSI-2 high-performance hard drive
- PCI Matrox Millenium graphics card with 3D acceleration and 2 MB of WRAM, upgradable to 4MB or 8MB
- 7 mass storage shelves (5 front accessible)
- 6 expansion slots: 3 PCI, 1 PCI/ISA combo and 2 ISA
- 10 BaseT/100VG AnyLAN selectable PCI NIC with up to 100 Mb/s throughput
- Integrated 16-bit audio and 4X CD-ROM
- Microsoft Windows NT 3.51
- Free three-year limited warranty for parts and labor[1]

from $5,159*

HP Vectra XU 6/150

Exceptional performance and expandability at an affordable price.

- Intel Pentium Pro 150 MHz processor with 256KB integrated cache
- 128-bit high performance memory architecture
- 16MB of DIMM memory standard, expandable to 256MB with 8 DIMM memory expansion sockets
- 1,000MB** Enhanced-IDE hard drive
- PCI Matrox Millenium graphics card with 3D acceleration and 2MB of WRAM, upgradable to 4MB or 8MB
- 7 mass storage shelves (5 front accessible)
- 6 expansion slots: 3 PCI, 1 PCI/ISA combo and 2 ISA
- Integrated 16-bit audio and 4X CD-ROM
- Microsoft Windows NT 3.51 or IBM OS/2 Warp
- Free three-year limited warranty for parts and labor[1]

from $4,519*

HP Vectra VT

Since Compaq and IBM don't get the concept of 'value pricing,'

HP PCs would like to shed some light on the subject.

What it *doesn't* mean: bare-bones PCs with pared-down prices. What it *does* mean: PCs with all the features you need for much less than you'd expect to pay. Five prime examples are highlighted here. Compare their features and prices with the other leading brands, and you'll see why HP is the only one inviting comparison. Our entire line represents the best values in the business PC market. From value-priced Pentium® processor-based PCs to our blistering hot, dual Pentium Pro processor-based HP Vectra XU PC.

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Polaroid Electronic Imaging Systems has upgraded the $99 imaging software, **SprintScan**, that's used with its $1,995 SprintScan 35, a 35-mm slide and film scanner. Now in Version 2.5, the Windows 95–compatible software provides improved manual and automatic prescan image enhancement and manipulation.

Polaroid's new $9,995 **SprintScan 45** is a high-end, multiformat film scanner for slides and negatives ranging in size from 35 mm to 4 by 5 inches. The single-pass SprintScan 45 scans 36-bit color images at a 2,000- by 4,000-dot-per-inch (dpi) optical resolution, and it has a density range of 3.4.

Formerly limited to the Macintosh market, Minolta Corp.'s low-end $1,995 **QuickScan 35**, a 35-mm film scanner, now has 16-bit Twain drivers for Windows. The single-pass QuickScan 35 scans 30-bit images at an optical resolution of 2,800 dpi and a density range of 3.0.

Polaroid Electronic Imaging Systems, Cambridge, MA; 800-816-2611, 716-256-4436; http://www.polaroid.com. *Circle 409 on reader service card.*

Minolta Corp., Ramsey, NJ; 800-964-6658, 201-825-4000; http://www.minolta.com. *Circle 410 on reader service card.*

Voting Fever

THE FLURRY OF PRESIDENtial primaries may be over, but Campaign '96 is just getting started. It's still a long way to Election Day, and Virtual Entertainment's **Vote America** will help you get there. This $20 CD-ROM provides a comprehensive political guide to the presidential-election process and keeps you updated via online links with the Vote America Web page and integration with America Online.

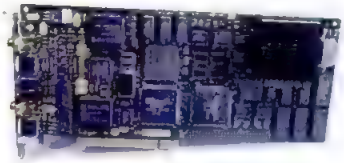
Other Internet-based sources for up-to-the-minute election information include CBS News' **Campaign '96** Web site at *http://www.cbsnews.com/campaign96*, and *Time*'s collaborative effort with CNN, **AllPolitics**, located at *http://AllPolitics.com*.

Virtual Entertainment Inc., Needham, MA; 800-301-9545; http://www.virtent.com/vote. *Circle 407 on reader service card.*

Capturing and Editing Video

YOU, TOO, CAN CAPTURE video images and edit them on your PC. Sigma Designs' $4,995 **REALmagic Producer** (a REALmagic-compatible MPEG playback card is required) is a complete solution for professional, full-screen MPEG video authoring. This upgrade adds 32-bit code, Video Batch Processing for running long projects overnight, selectable I-frame insertion, and the ability to play .AVI-editable MPEG files back to a television or VCR. Included is a 32-bit PCI audio and video MPEG encoder card, Adobe Premiere, Caligari TrueSpace, and a frame-accurate videotape-recorder controller.

If you just need to edit video, Ulead Systems' $349 **MediaStudio Pro 2.5** now has both 32- and 16-

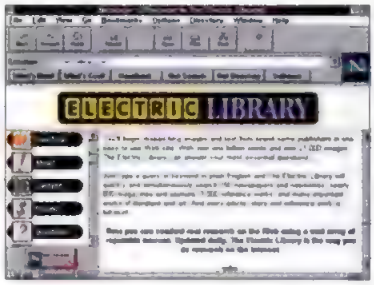


bit Video Editor and Video Capture modules, subpixel rendering, and more motion effects.

Sigma Designs Inc., Fremont, CA; 800-845-8086, 510-770-0100; fax, 510-770-2640. *Circle 405 on reader service card.*

Ulead Systems, Torrance, CA; 800-858-5323, 310-523-9393; fax, 310-523-9399. *Circle 406 on reader service card.*

E-Library



INFONAUTICS CORP. brings its online research service, Homework Helper, to the Internet with **Electric Library**. Located at *http://www.elibrary.com*, Electric Library costs $9.95 per month for unlimited access. The online database provides users of all ages access to an immense repository of graphical and textual reference information. The full text of over 150 newspapers, 900 magazines, and thousands of books and reference volumes is represented. Electric Library lets you conduct research using natural-language queries via a solid search engine.

Infonautics Corp., Wayne, PA; 800-247-7644; info@infonautics.com. *Circle 413 on reader service card.*

BRIEFS

Business Software

Made2Manage Systems has brought its namesake product to the Windows platforms. With prices starting at $10,000, **Made2Manage for Windows** is a 32-bit version of a complete sales, manufacturing, and financial management package (800-626-0220) .... Provident Ventures offers interactive, Fortune 500–level corporate and professional training for individuals with its $149 **Unlocking Our Potential** CD-ROM (800-546-3019) .... SoftSys now has a 32-bit version of **SoftSys EstimatorPlus** available. This $100 package is a full-featured project-estimating and expense-tracking solution that also monitors sales-closing ratios, client-list receivables, and taxes paid and collected (905-619-8093) .... Data Broadcasting Corp. offers **Signal**, a 32-bit data-charting and stock-analysis package; prices range from $60 to $280 per month, after a start-up fee of $300 (415-571-1800).

Software

Planning a road trip? Route 66 has brought its popular Macintosh **Route 66** software to the Windows and Windows 95 platforms. The $59.95 software will help you calculate your journey's routes and provide estimates of your travel expenses (408-446-0660) .... JASC's $149 **Illuminatus Version 3.0** is an entry-level multimedia-authoring tool featuring an improved interface and greater functionality (612-930-9800) .... Is the version of solitaire that ships with Windows 95 not enough to suit your needs anymore? Interplay Productions offers the $30 **Solitaire Deluxe for Windows 95**, with 24 new games to play when you're between conference calls (800-468-3775).

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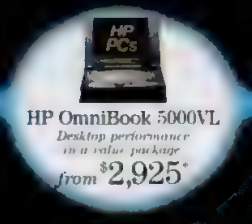

*Average U.S. street price. [1] J.D. Power and Associates 1995 Notebook Computer End User Satisfaction Study. Office Based Businesses. Study conducted among 1,133 respondent users. In Canada call 1-800-[illegible]-367.
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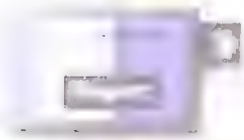

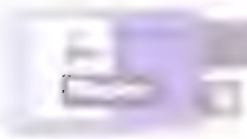

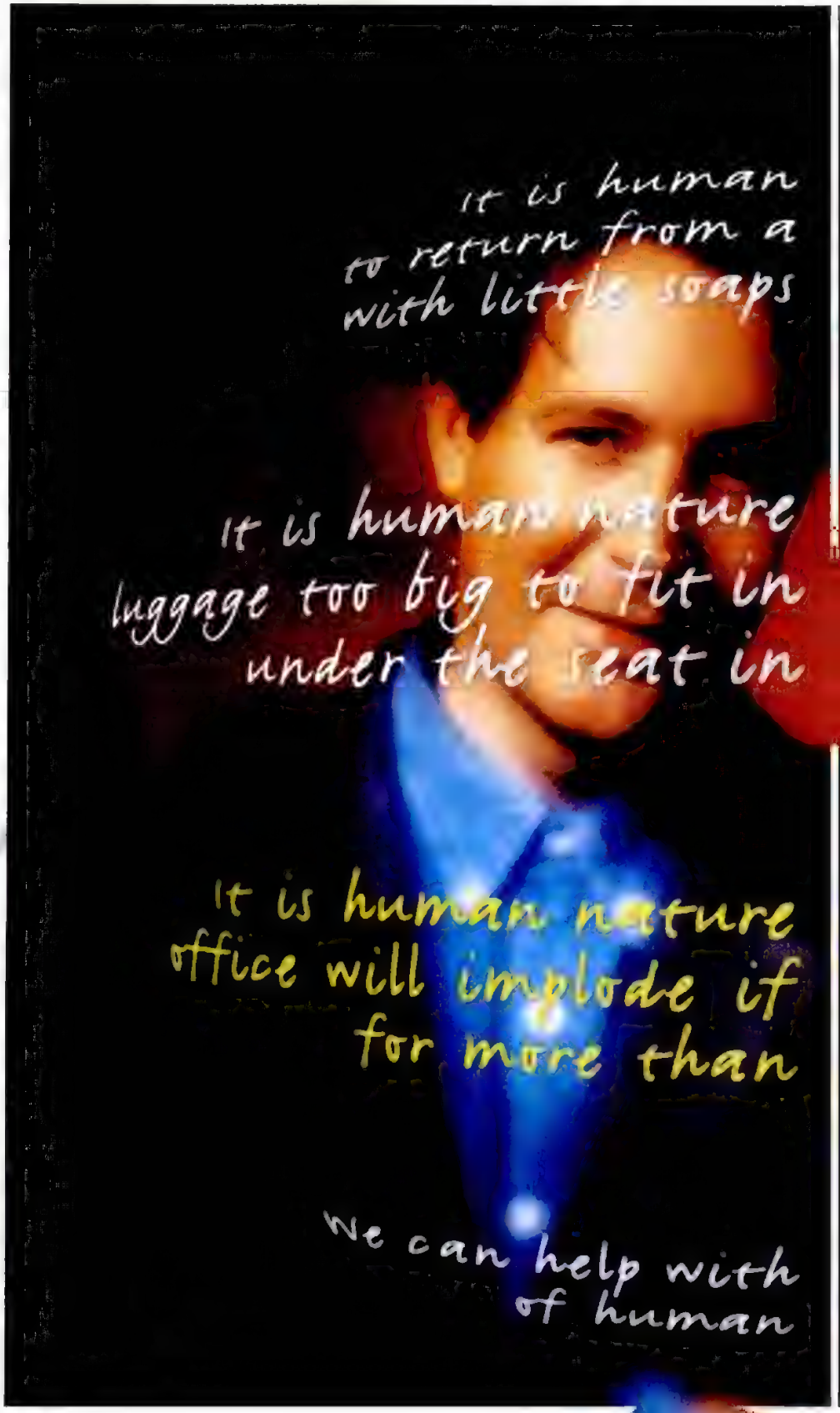

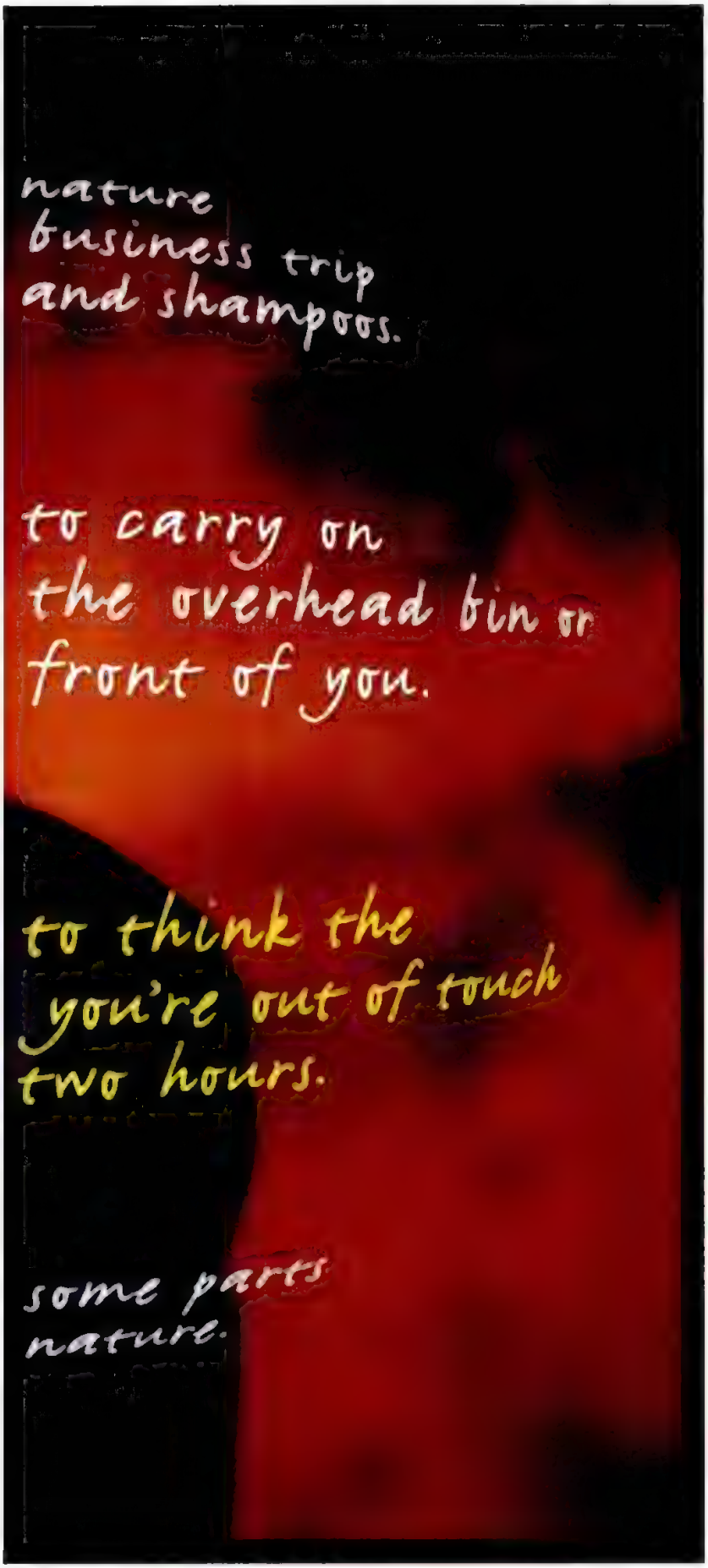

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Enough, Already!

This browser business has gotten out of hand. Everything's a browser. HTML is the presentation layer for just about every new application that can limp onto your screen. Indeed, Microsoft is even showing a browser that can look at the Web or files on your hard disk with equal ease. JavaSoft is about to ship Java Workshop, a development environment for creating Java code; each component appears as a Web page.

The browser metaphor is not the Last Great User Interface. In fact, it's pretty bad. It's bereft of most of the useful controls that we've come to know and love. It's overburdened with big, graceless buttons and that stupid animation in the upper-right corner, which tells you nothing more than "working . . . ." The forms tools are downright ugly, not to mention inflexible.

Should the next version of CorelDRAW be a browser? Quicken? How about Excel? No, no, and no. What's the browser equivalent for Corel's roll-ups, those handy tear-off menus that speed your layout tasks? What's the browser equivalent of Quicken's checkbook? And do I want to see a meteor shower every time my spreadsheet recalculates?

The browser metaphor is the computer equivalent of platform shoes—great for people who want to be taller, but essentially ugly and uncomfortable. I find it hard to imagine that browsing your hard disk is better than using the sophisticated, hierarchical display/viewer technology that began with The Norton Desktop. But when you have a hammer, everything begins to look like a nail.

Software designers need to ask, "How can I seamlessly integrate this application with the Internet without hobbling my users?", not "How can I give this thing a Web look and feel so people will think we're up to date?"

BROWSER BURNOUT

Browsers are like platform shoes—great if you want to be taller, but essentially ugly.

One of the good things about Web browsing is that people are reading more. Web use is on the rise as a leisure activity, and surveys we've seen indicate that the free time comes out of TV's hide. This does much to assuage my fears of a truly postliterate society, so while I've got an inch, I might as well try for a yard. Herewith are three books worthy of your attention:

The Microcontroller Idea Book, by Jan Axelson (Lakeview Research, ISBN 0-9650819-0-7). Microcontrollers are microprocessors that have been specifically adapted to work with real-world devices such as switches and sensors, while controlling displays, motors, and lights, or collecting data to feed into a PC. Axelson's book deals primarily with the Intel 8052-BASIC, an 8-bit chip with an on-board BASIC interpreter and a host of useful features. The real gold in the book is the collection of input/output circuits that show you how to connect to the outside world and have it all work properly. The writing is a model of clarity and conciseness. Once you know how these things work, you can use them cookbook-style.

As long as I'm revealing my wirehead side, I'll mention *Mobile Robots*, by Joseph L. Lee and Anita M. Flynn (AK Peters Ltd., ISBN 1-56881-011-3). This book is an outgrowth of research done at MIT's Artificial Intelligence Lab. One of the simplest robots is made with Legos, inexpensive motors, a circuit board, and some parts. Legos and toys figure prominently in other, more sophisticated robots that use microprocessors for brains. You can build some surprisingly capable little critters that will scuttle around, find their way through mazes, and not trigger anyone's allergies. Also check out *http://legowww.homepages.com/robots/index.html.*

And then there's *A Guide to Publishing User Manuals*, by Ken Whitaker. Finally! Someone has documented the documentation process. Whitaker is the author of *Managing Software Maniacs*, another of my favorites. While *Managing Software Maniacs* is crammed with pithy, humorous advice, the documentation book (John Wiley and Sons, ISBN 0-471-11846-X) is sterner stuff, although still rendered with a deft hand. Most important are the passages dealing with documentation's role in an overall project and why it's not a natural fallout of the development process. If your boss has ever bridled at budgeting for proper documentation, this is required reading.

For balance, I should include *Middle Passage*, by Charles Johnson, and *Murther and Walking Spirits*, by Robertson Davies. They don't have a darned thing to do with computers; they're just two of the better books written in the past decade or so. □

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PC MAGAZINE CIRCLE 106 ON READER SERVICE CARD

Why Microsoft Will Beat Netscape

The writing is on the wall for anyone who wants to read it. Microsoft will beat Netscape in the Web-browser battle. All you Webmasters out there who are putting "best when viewed with Netscape Navigator" links on your Web pages had better reconsider. Several recent incidents have convinced me that Netscape is fast approaching the end of the road.

The first inkling I had of this was when a friend of mine, who is definitely in the know, installed Internet Explorer on his Macintosh before Netscape had shipped Version 2.0 for the Mac. When I asked him why, he said he believed Microsoft had won the battle. Initially, I thought this was amusing because Netscape has 80 percent of the market. But apparently he was impressed with the speed at which Microsoft had moved to the Macintosh platform. And his comment seemed significant in the light of his dislike of Microsoft.

NETSCAPE'S D-DAY

What is Netscape going to do against this onslaught? What *can* it do? Nothing.

Then came the America Online fiasco. Netscape made a huge announcement about how AOL would use Navigator as the browser for its GNN Internet service. Hoopla ensued. Analysts hailed the joint venture, predicting that it would cement Netscape's frontrunner status. A day later, Microsoft waded in and quickly stole the spotlight. Suddenly, AOL had agreed to make Explorer the primary browser for the 5 million-plus subscribers of its online service. In exchange, AOL secured a place on the Windows 95 desktop.

Microsoft has made the biggest about-face for a large company by pulling the plug on MSN, its online service, and recasting it as an Internet-access provider. Following Netscape's lead, Microsoft has said Internet Explorer will always be free. Microsoft's browser will be bundled with all versions of Windows, including Windows NT. What is Netscape going to do against this onslaught? What *can* it do?

Nothing, and the irony of this is that Netscape has no clue this is even happening. The company has never competed with the likes of Microsoft. Most members of the Netscape team are Unix retreads and workstation geeks with no connection to low-end computing. And they have few allies in the desktop world. Most people who deal with Netscape remark about the incredible arrogance of its personnel, "worse than Microsoft ever was," they say.

You get the sense that anyone ever involved with Netscape would love to see Microsoft humiliate the company, myself included. Don't get me wrong, I'm no Microsoft booster. But I recently had the unfortunate displeasure of meeting Jim Barksdale, Netscape's CEO, for a panel discussion, and I was shocked by his unwillingness even to chat. On the panel, he managed to insult the moderator, who was with *Forbes* magazine, while complaining about what a poor job Netscape does with the media. Afterwards, he became upset, because a limo wasn't waiting curbside to take him to the airport. Nevertheless, he refused an offer of a ride in a plain old car, instead preferring to wait for the limo.

Netscape is one of a handful of Silicon Valley companies, led by Sun Microsystems, that suffer from the delusion that Microsoft is just an aberration. According to this notion, all it will take is a swift kick from the old minicomputer hacks to stamp out Microsoft for good. Remember that Jim Clark, chairman of Netscape, hails from Silicon Graphics, another workstation company with no experience in the low-end market.

The spiritual leader of this group, though, has to be Sun CEO Scott McNealy, who brags about being the biggest Microsoft basher. As a result, one of the great hardware design and manufacturing companies continues to focus on software for no apparent reason. This has led to the misguided belief that a Java word processor with five functions will somehow dethrone Microsoft Word because it's free. Let me tell you guys something: Nobody has ever stood up and ridiculed Microsoft without paying a heavy price.

The same forces are at play within Netscape. I trace it to the fact that both Netscape and Sun are backed by the same group of high-tech venture capitalists, a small clique of friends who seldom leave the comfort of their limos.

Of course, the whole thing may be cosmic. I've always had a feeling people get into a dangerous comfort zone in business. Perhaps Jim Clark's destiny is to make a good product but always be second best. Maybe Netscape will be content to be number two to Microsoft. There is no doubt in my mind that this is exactly where the company is heading. □

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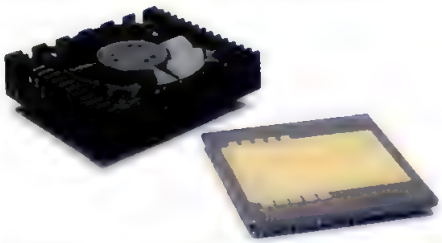

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CIRCLE 080 ON READER SERVICE CARD

JOHN C. DVORAK

Inside Track

With the approach of its Pentium **MMX chips,** Intel is getting closer by the minute to locking up the entire market for desktop computing. Since discussing Intel's possible MMX strategies in the April 9, 1996, Inside Track, I've become even more convinced that Intel's MMX circuitry—due by the end of the year—will revolutionize the PC industry. Combined with Digital Video Disk (DVD) technology, also expected this year, MMX technology could signal a significant change in the computing landscape. Two readers wrote to me with comments on the MMX strategy.

You have to expect serious flaws in the Java model; its entire existence was based on a dream of interactive TV that never materialized. Anyone who bought into that wasn't thinking straight.

One confirmed my argument that **Intel is more afraid of Cyrix** and its 6x86 architecture than of AMD, which is why the company set out to **thwart** Cyrix's own MMX-type extensions. He went on to claim that, from a chip-designer's perspective, it appeared as if Intel actually examined the Cyrix architecture and designed the MMX extensions in such a way that they **could not** be implemented easily (if at all) by Cyrix. "It would take at least a year for Cyrix to catch Intel if MMX takes off," I'm told. This is the reward Cyrix gets for having a chip on the market that is actually more powerful than the Intel processor at the same clock speed.

Another reader offered that the MMX extensions shouldn't even be thought of as multimedia extensions but as "matrix-manipulation extensions." In fact, using the term *multimedia* may just have been **a red herring,** as matrix math may be what this is really all about. With the ability to work with, I'm told, up to eight numbers at once, with MMX the approximate 250-MIPS processing power of the 166-MHz Pentium chip suddenly becomes the equivalent of **1 billion instructions per second.** This accounts for the rumors that Intel is claiming MMX can run Adobe Photoshop four times as fast as plain Pentium chips. This is on top of all the sound and video capabilities also incorporated in MMX.

Not Standing Pat Dept.: Microsoft is also in the news with a number of screwball announcements of late. I started wondering what's going on in Redmond when a friend told me that Microsoft has more people working on Internet products than on any other single project. This made absolutely **no sense** until I started thinking about it. In effect, Microsoft is adopting **an Internet strategy** for each and every aspect of its product line. In other words, even some of the OS people are trying to figure out a way to **shoehorn** the Internet directly into Windows.

Here are some **predictions** based on Microsoft's past performances:

• Look for a **Web hook in every Microsoft product.** Within a year, all the programming languages will have HTML and other hooks to **oust Java.** Microsoft may have licensed Sun's programming language, but don't think the company is caving in to Java—a primitive subset of C++ originally designed to control a set-top box in an interactive-TV environment. You have **to expect serious flaws** in the Java model, since its entire existence was based on a **false premise:** a dream of interactive TV that never materialized. Anyone who bought into that notion wasn't thinking straight. Of course, if you think about it, Microsoft was **also suckered.** But Microsoft, unlike Sun, knew when to bail out.

• Expect to see Microsoft make a **Visual Java** just in case its own products cannot untrack the Java promise. I'd expect to see an I-BASIC (Internet BASIC), as well as various implementations of HTML. One will be **a Web-enabled Microsoft Publisher,** replete with templates making Web design not only easy but probably fun and attractive.

You Say You Want Bandwidth? Dept.: More aggressive activity may come from an unusual alliance between Microsoft and Hughes Electronics. Observers see Microsoft **using the DirecTV system** to deliver TV and data to PCs in early 1997. Here's some information from an industry newsletter, *Satellite Business News:*

Microsoft will develop software to allow PCs to display digital video, audio and data signals from DSP [Digital Signal Processor] satellites on a computer monitor. . . . Microsoft has also obtained licenses from DirecTV and Thompson Consumer Electronics Inc. to develop a consumer card [to receive and decode signals from DirecTV's 18-inch satellite dishes] that can be inserted into current multimedia PCs and built into new-generation computers later this year. . . . Exactly what content the PC will convey has not yet been determined. DirecTV has reserved 30 megabits [per second] of bandwidth on its DBS-3 satellite for applications that will use Microsoft's platform.

I wonder why the computer press has not paid more attention to this story. The press must assume that Microsoft is **keeping a lid** on its plans, which are probably all Internet-related. I've been baffled by Microsoft's attempts to promote specialized MMX-type extensions over the standard extensions to be built into the MMX Pentium. Microsoft must have its **own agenda,** and this satellite scheme may be a part.

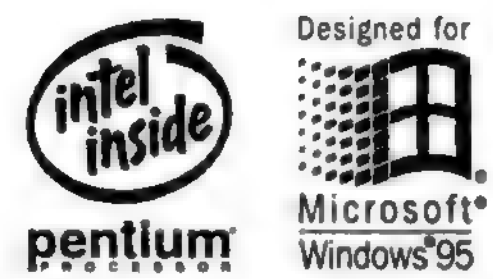
The Final Straw Dept.: Just to add another **twist,** over the next year or two expect to see some Taiwanese and Korean firms promoting **direct satellite Internet uplink hardware** costing **less than $2,000.** Acer is said to have one in the works based on the technology developed for those **satellite phones** that fit in large suitcases. Is this scene heating up or what? My comment: ***Ay caramba.*** □

O'Hare Airport: 4.3 miles of terminals.

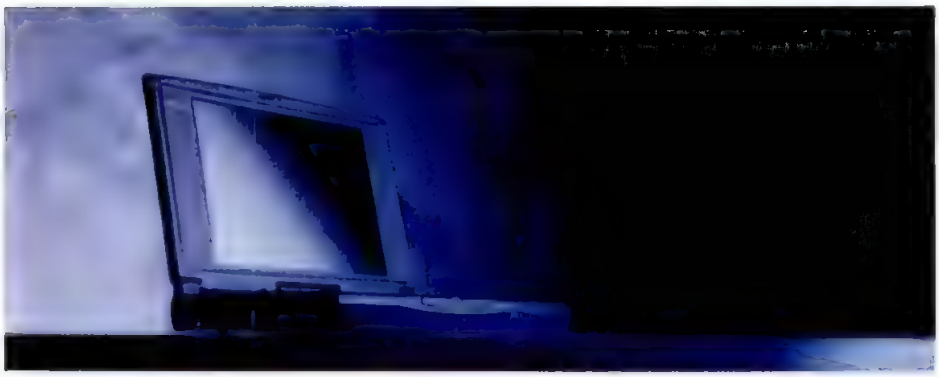
Dallas/Ft. Worth: 4.8 miles.

Denver International: 3.2 miles.

(It occurred to us you might want a lighter notebook.)



Of course, it also occurred to us that you don't want to lose features while losing weight. Thus, the new AcerNote™ Light notebook computer offers a Pentium® processor, full-size keyboard and large 10.4" color screen.



But it still weighs just 5.8 pounds. Which we think you'll appreciate when you're traveling from, say, Dallas to New York. Half the distance of which is covered while walking to the gate. ACER

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(It also occurred to us you might want other options.)

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CIRCLE 087 ON READER SERVICE CARD

JIM SEYMOUR

The Risks (and Rewards?) of Innovation

The PC industry is built on innovation, of course. The old line that if the auto industry had progressed as far as PC makers have, we'd all be driving $500, 100-mile-an-hour limos getting 200 miles to the gallon has a whiff of truth about it. And business gurus invariably use the PC industry as the 20th century's preeminent example of the rewards—to both society and individual entrepreneurs—of technological innovation.

But innovation can get risky, especially for those who innovate most aggressively and for those who try to innovate within structured, maturing businesses, where widely adopted standards hold sway. Like, umm, the PC business.

As hotshot PC users, we like to pride ourselves on our openness to innovation. Indeed, we often say we *demand* aggressive development cycles for new products. Too often, that's so much hot air. When it comes to real innovation, we can be awfully retrograde in our openness. In large companies, many technology managers are actually complaining about the pace of innovation: By the time they get their POs approved, the products they're trying to buy have been superseded by new models. Couldn't we move forward just a little more *slowly?*

We've been held back for years by our devotion to the Intel *x*86 processor instruction set, in tandem with good old DOS. New alternatives may be better or faster . . . but unless a new product is compatible with everything on our desks now—and everything in our file cabinets and storage rooms—we're not interested, thanks.

What about Windows 95? Pentium chips? Notebook PCs? Evolutionary, all. And each of them burdened and ultimately compromised by our insistence that everything new work with everything old.

EVOLUTION

PC innovations are burdened by our insistence that everything new work with everything old.

But surely innovation is a good thing. Compaq, for example, built a business around it, in a narrow sense. As cofounder and former CEO Rod Canion used to say, "Compaq innovates within The Standard." By which he meant that Compaq established itself with the first 20-pound, suitcase-size, portable IBM PC–compatible computer. But compatibility with the existing IBM PC/DOS standard was at least as important to the company's success as the portability of those Compaq luggables.

Now, Compaq is trying a riskier game. Indeed, Compaq makes a good case study of the risks, and possible rewards, of innovation in the PC business today. A recent visit to Compaq's campus in the piney woods country north of Houston confirmed that riskiness: Managers actually spoke of innovating *outside* the standard. That would have been heretical—even grounds for firing—just a few years ago.

But Compaq—and Dell, Gateway, Hewlett-Packard, Micron, and everyone else in the PC systems business today—faces a tough problem: how to stay within the compatibility box, yet distinguish itself from the competition.

Lower prices aren't enough any more; prices fall every 90 days or so—*everyone's* prices are low, and they're all about the same.

Performance is nearly as uniform as prices now. Intel chopped off at the knees PC makers' competitive advantage from in-house engineering innovation when it jumped into the PC motherboard business three years ago. In 1995, Intel made about a third of the motherboards in PCs sold in the U.S. Intel says it doesn't really want to be in the mobo business, hardly wants to stifle innovation, and selflessly builds all those mobos only to help its customers get new Intel chip designs to market more quickly. Sure, Andy.

As our PC Labs tests show, there are differences in performance within classes of PCs today, but usually only small differences among similarly configured machines from the top vendors. Performance still counts, certainly. But it's not nearly so hard or expensive to create, or even buy, competitive performance as it once was.

How else to compete? Well, though featuritis is still alive and kicking—witness Hewlett-Packard's silly little built-in snapshot scanner in its new PCs and Compaq's more useful page-size scanner built into its new keyboards—piling on features and gizmos isn't enough. Almost overnight, everyone else has those new gizmos too, because everyone buys from the same Asian sources.

Compaq's efforts in the recent past to bring real innovation to the PC market have met with mixed results. The engineering has been consistently good, but you and I haven't shown much respect for it. Compaq's unique, proprietary

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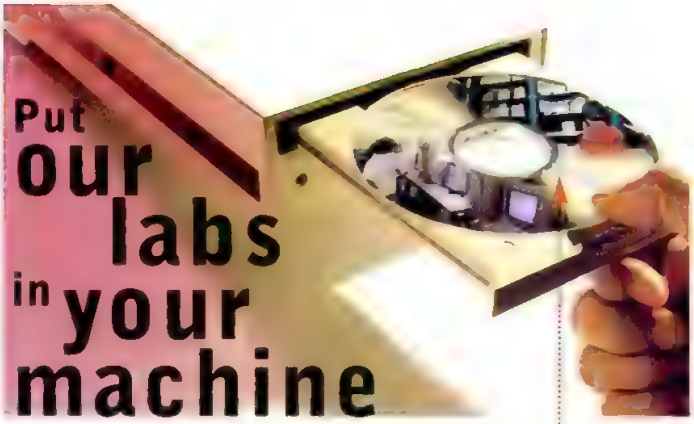

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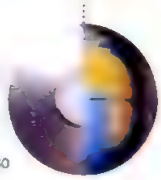

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JIM SEYMOUR

TriFlex memory architecture was a better idea when it was first introduced three years ago—and it's still a classic better idea. Unfortunately, customers aren't yelling "attaboy!" and lining up to purchase Compaqs because of TriFlex; instead they're asking, "Umm, well, how is that different from The Standard? Couldn't you just use the same memory architecture everyone else does? You know, we like to stay within . . . The Standard."

Don't shed any tears for Compaq, though: It's king of the hill in PCs right now, on top of the server market by a mile and headed, I think, for a great couple of years. Even its lost-in-the-desert-lo-these-many-years portables business is back on track. It's doing lots of things right.

That includes that new approach to innovation: Jump outside the box and push hard for new extensions to The Standard. And in the process, Compaq is showing its willingness both to give away to its competitors the fruits of its work in order to make these extensions part of The Standard and to knock heads when it thinks the other guys Just Don't Get It. The development of the new Universal Serial Bus is a good example: A great deal of the work on that standard, and much of the behind-the-scenes knee-breaking to get other vendors on board, was done by Compaq. Look for more of that from Compaq later this year.

That's an especially risky kind of innovation. While Compaq is increasing the pie for everyone, it is gambling that it will be fastest to market, in the most appealing implementations, with these new extensions. If it fails on either count, it will have spent its shareholders' money enriching its competitors.

Compaq executives acknowledge that it's a risky path but ask, fairly, if they have any choice. As a market-leading, premium-price brand, they can either push these outside-the-box innovations and then try to grab a disproportionately large share of the rewards, or they can see the reputation they've worked to build—the reputation that allows them to charge those premium prices—disappear.

I agree that this is the right kind of innovation for today's market: broad, far-reaching improvements in The Standard to which we have become so wedded. Compaq benefits; the industry benefits; you and I benefit.

But it's still a risky strategy, one that depends not only on skillful execution but also on the great, imponderable variables in the equation: you and me. The real unknown: Are we still eager to acknowledge and reward innovation? □

The Little Laptop That Could

If you're in the market for a new notebook PC in the second half of the year, you'll have three categories from which to choose: full-featured, value, and, once again, subnotebook. As has been our tradition for the past five years, *PC Magazine* will review the new crop of notebook computers in our August issue. Until then, here's an interim report on what we've seen coming into PC Magazine Labs, as well as what vendors are planning for the end of 1996 and the beginning of 1997.

Virtually every notebook model now has a color display, built-in sound, and the option of a CD-ROM drive. The bulk of the notebook market will be the value lines, which will include most of the features of current full-featured systems but at a cost of $2,000 to $3,500, rather than $4,000 and up. So what will distinguish a high-end notebook? It may have L2 (external) CPU cache; faster and higher-resolution graphics with more on-board memory; 16MB of RAM standard; a PCI rather than VL- or proprietary bus; a modular bay for swapping CD-ROM drives, floppy disk drives and a second battery; lithium ion rather than nickel hydride batteries; wireless infrared (IrDA) communications; MPEG video decoding; NTSC (TV) video input and output; a telephony modem; and beefier construction.

SUBNOTE REDUX

Users have discovered they can get along just fine without a built-in floppy disk drive.

The most significant trend is the return of the subnotebook. Users have discovered that they can get along just fine without a built-in floppy disk drive, and in doing so they get a powerful computer that weighs less than 5 pounds. Virtually every major vendor will offer a subnotebook this year or by early 1997. All will come with floppy disk drives that you can take with you or leave behind, saving just under a pound of travel weight. The drives may be external and tethered by a short cable, in a slide-out bay (which you can leave empty or fill with a second battery), or in an expansion module that fits under the system unit. And they'll no longer be the exclusive playthings of power users. Many will be value-line Pentium subnotebooks that cost $2,000 to $2,500 with color screens.

The other major trend is the big display. By the time you read this, you should be able to buy 12.1-inch active-matrix color displays with 1,024-by-768 or 800-by-600 resolution on higher-end systems. We've seen systems with 12.1-inch displays, and the images are dazzling. More common and more affordable will be 11.3-inch and 10.4-inch displays, either active-matrix or dual-scan color, typically with 800-by-600 resolution. For roughly the same price a vendor may offer 11.3-inch dual-scan displays and 10.4-inch active-matrix displays. The very bottom end will be the 10.4-inch DSTN (dual-scan) display with VGA color resolution. Because of the closer viewing distance, 12.1-inch notebook displays will be acceptable at 1,024 by 768 for most users.

Those big displays mean the case has to be 8.5 by 11 or 9 by 12 inches, and that spells the end of the miniaturized keyboards found on Toshiba's high-end Portégés as well as the unique IBM 701C Butterfly notebooks. For pointing devices, the touch pad continues to gain ground. It's so easy to learn that new users feel comfortable with it in about 10 minutes, although I'm not sure how much more skillful you become over time. For trackball fans, Logitech's optomechanical design seems to resist the finger-oil buildup that causes pure mechanical trackballs to slip. I'm still a big fan of the pointing stick used by the top two vendors, IBM and Toshiba. IBM invented the technology and typically licenses only previous generations to competitors. The pointing sticks on IBM ThinkPads are noticeably superior.

Drive sizes of 1.2GB will be available even on value systems. Some of the very thinnest notebooks will be limited to 810MB because they use single-platter, 12-mm drives. Looking toward early 1997, we'll see 2GB, 2.5-inch hard disks and 13-inch displays. One feature I'd like to see on a 1997 notebook is 3M's new LS120, a drive that reads and writes standard 1.44MB floppy disks as well as the new 120MB disks.

The future also poses some problems. Most significantly, we may hit a wall in processor performance. Beyond 133 MHz, the current top end in portables, even the lowest-voltage Pentium CPUs radiate so much heat that a fan will be mandatory, vendors say. And for the near term, advances in battery technology won't keep up with the greater power drain of the CPU, fan, additional memory, and bigger display. So 2 hours may be the most you can expect from the battery. □

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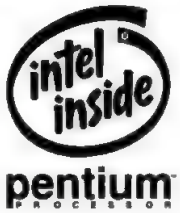

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Slots: 4 PCI, 4 ISA	SLOTS: 4 PCI, 4 ISA	12 Bay Tower, 8 Removable	512K Cache on Each CPU Module
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ILLUSTRATION BY STEVEN DINNINO

By Charles Lin

As a company branches out geographically, the network administrator is charged with connecting all locations to the corporate network. Keeping the flow of information constant during such transitions helps your business maintain a competitive edge. You likely will need a router at every remote site—each one must be able to talk with the router at the central site and at all the other remote sites.

INSIDE

PC MAGAZINE

Even if you've managed to avoid routers of any kind in your network to this point, you probably cannot avoid them forever. And even if you don't have far-flung branch offices and remote users that require routers (yet), chances are you'll want to connect to some other entity at some point that requires a router. But take heart. Like other areas of networking, routers have gotten some much-needed usability attention from vendors.

WE'D NEVER SUGGEST ROUTERS are easy to use (well, okay, maybe to a true router veteran we might), but they have gotten somewhat easier. That's especially true for the remote-site routers we review in this issue. Author Chuck Lin takes us through installing and configuring remote-site routers from three major vendors.

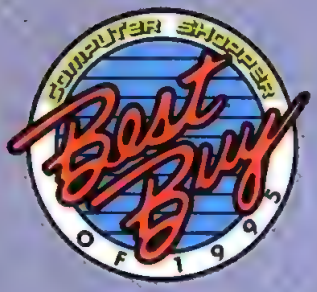
THERE ARE MORE USER-friendly routers in First Looks. Frequent contributor Les Freed reviews Shiva's entry into the ISDN router market, the Shiva Integrator 100. We had this single-BRI-line device operating in only 10 minutes. It's got lots of great features to help save money on your connection costs. Its only drawback is the lack of an integrated NT-1, which, says Shiva, is coming in future releases. (NE21)

IN ADDITION, RYAN Tabibian gives us a look at the Farallon's Netopia. This ISDN router combines good management options, helpful administrative tools, and a bundle of applications to get you up and running. Although targeted for connecting to the Internet, it also can act as a remote-site router. (NE22)

FINALLY, DOES THE thought of freshly toasted NICs make your skin crawl? We thought so. Find out from PC Labs, West Coast director Steve Buehler what you can do to avoid this delicacy in Multiple Access. (NE26)

—Gail Shaffer

MAKE THE CONNECTION



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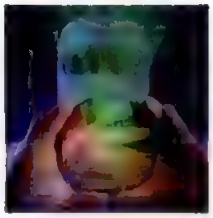

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- 8X SCSI-2 CD-ROM drive, 3.5" floppy drive
- PCI 64-bit video, MPEG, 2MB EDO
- Full-size tower with 10 drive bays
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January 1996 PowerServer SMP P133

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CIRCLE 924 ON READER SERVICE CARD

These branch-office—or remote-site—routers are less expensive and somewhat less complicated than their central-site counterparts. But they're still routers—with routing tables to be established and filters to be set. You'll need routing expertise to set them up and manage them—but not necessarily at the remote site.

We recommend that you purchase the remote router from the same manufacturer as your central-site router. Deployment and management will be much easier with a complementary pair. And most remote-site routers are priced surprisingly well: around $2,000 to $3,000.

After the initial hardware investment, the two long-term costs you'll face are the monthly WAN circuit charges and the expense of hiring someone to install and manage the router. You have some options, though, for keeping costs down.

We tested remote-site products from three major players in the router market. Each router is designed to work with a central-site router from the same manufacturer: Bay Networks' BayStack Access Node Hub, Cisco Systems' Cisco 2516, and 3Com's NETBuilder Remote Office 221. Each is a good choice. Our reviews concentrate on ease of deployment, WAN optimization, security, and ongoing management. Each factor can affect the cost of connecting your branch office.

3Com NETBuilder Remote Office 221

We deliver our Editors' Choice for this product set along with our observation that you'll simply run into fewer problems if you go with a remote-site router from the same manufacturer that supplied your central-site device. Each of the routers in this set is first-rate, with as much approachability as routers can have at this point. So we're comfortable recommending any of these routers—depending, of course, on the name on your central-site router.

We singled out the 3Com NETBuilder Remote Office 221 for our Editors' Choice because its solution, to a somewhat greater degree than the other two products', embodies the whole idea of remote-site routing. That is, needing a remote router doesn't necessarily mean needing a router expert to set up shop at the remote site.

The principal technology behind the 3Com strategy is Boundary Routing, a proprietary technology that creates a bridge rather than a route across the WAN link. This means you'll have less of a need for assistance at the remote site than you'll have with the very fine implementations from Cisco Systems and Bay Networks.

There certainly are trade-offs with all three products. Price, however, is less an issue than your connection requirements, WAN choices, and preferences in management interfaces.

PC MAGAZINE NETWORK EDITION EDITORS' CHOICE

SO EASY MY MANAGER COULD DO IT

Remote-site routers should deploy easily and require little or no administration at the remote site. These routers can be (so-called) plug-and-play, provided you can use the central-site device to configure and manage them remotely. Each vendor here implements plug-and-play in its own way.

Frame relay seems the best choice for the WAN connection in a plug-and-play situation. The frame-relay switch communicates with the router well enough for the router to set up the connection itself. Once the connection is up, the router can fetch its configuration from the central site. It can do the same over point-to-point using HDLC.

The Bay Networks and Cisco remote routers grab their configuration from a Bootp or TFTP server on the central-office LAN. 3Com takes a different approach with its Boundary Routing, which enables the remote router to auto-configure its WAN interface and act as a smart WAN bridge. Thus, the 3Com device does not require fetching the configuration file from a Bootp server.

The next challenge lies in getting the most out of the relatively low-bandwidth wide-area link. Broadcast packets that take up a small percentage of a 10-Mbps Ethernet can cripple a 64-Kbps frame relay or even a 128-Kbps ISDN or point-to-point link.

Understanding network protocols, services, and WAN tariffing can help you to streamline your WAN usage. A homogenous network environment using IP is a dream. Most real networks support multiple protocols and server platforms, which can clog the WAN link.

On a NetWare network, filtering out broadcasts such as Service Advertisement Protocol (SAP) packets is only the first step in reducing traffic. For ISDN subscribers, these broadcasts would otherwise prevent the line from tearing down, translating into high monthly charges.

With chatty protocols such as AppleTalk, packet spoofing will keep the WAN clear by fooling the remote clients into thinking that the central site is responding. Spoofing also allows routers to respond to NetWare client "Get nearest server" requests if the remote site does not have its own local server.

Monitoring network traffic at the packet level is sometimes the only way to discover problems. During our testing, for example, we discovered that our remote clients were unable to log on to a Windows NT server using NWlink. A Sniffer trace revealed that the remote-site router was filtering out the necessary IPX Type 20 packet. A simple configuration change solved a problem that was difficult to diagnose.

Routing information protocols (RIPs) also generate unnecessary traffic. Creating static routes and filtering out RIPs will reduce the traffic, but you must make sure that all necessary network changes are updated across your WAN.

MORE BANDWIDTH, AS IF BY MAGIC

Imagine tripling your bandwidth without paying a dime more. Compression is the magic that optimizes your network bandwidth. Vendors use various compression algorithms: Cisco and 3Com license Stac's Stacker, while Bay Networks uses a proprietary algorithm called WCP.

Compression can also vary depending on WAN type. ISDN and point-to-point circuits may require the Compression Control Protocol (CCP), a part of Point-to-Point Protocol (PPP). Both ends of the network must negotiate the compression type and dictionary size before using compression.

SECURITY, THE PERENNIAL ISSUE

For a channel that must be secure against external intruders, ISDN dial-up connections and the public switching of frame relay give administrators the jitters. With frame relay, though, a hacker needs to control a telecommunications company's switch in order to tap into your company's permanent virtual circuits (PVCs). For highly sensitive data, we recommend encryption. Circuits that use PPP can be protected by using CHAP and PAP, which are password-matching schemes.

For protecting your network against internal intruders, static routes and filters

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Key Features	Oracle7	Sybase ~~System 10~~ SQL Server 11
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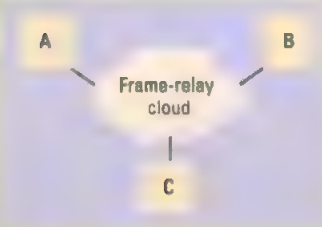
Frame Wins the Relay Race

By Robert P. Lipschutz

Of the different LAN connectivity options, frame relay usually offers the best cost/benefit value proposition. Frame relay is an excellent choice for connecting distributed LAN environments, and it provides relatively low-cost digital connections for today's popular network protocols—AppleTalk, IP, and IPX.

Frame-relay networks work on the principle of statistical multiplexing, a method whereby multiple logical connections lie over a single physical connection. In practical terms, this means that a network with a single physical access circuit into the frame-relay network has access to multiple destinations. In our example, site A can talk-simultaneously with sites B and C through different logical connections called permanent virtual circuits (PVCs). This saves money, because expensive physical connections are not required between every pair of physical sites. Contrast this with a point-to-point leased line connection that only connects two designated sites.



	Benefits	Drawbacks
Frame relay	Relatively inexpensive; scales well across multiple sites	Shared network can become congested
Point-to-point leased lines	Reliable; guaranteed bandwidth	Expensive; does not scale well across multiple sites
ISDN	Digital circuit with low error rates; switched circuit	Limited availability; per-minute charges in most areas
Analog circuits (POTS)	Inexpensive	Limited bandwidth; high error rates

Typically, the physical access circuit runs at 56 Kbps to 256 Kbps, but larger and higher priced circuits are available—up to T1 speeds (1.54 Mbps).

Frame-relay providers guarantee PVCs with a certain Committed Information Rate (CIR). A provider may sell you a PVC with a 64-Kbps CIR but allow you to burst up to 128 Kbps on that circuit. When the frame-relay cloud becomes congested, however, anything above the CIR may be dropped. Most router manufacturers will use FECN and BECN (forward and backward explicit congestion notification) to notify source and destination sites about congestion in the frame-relay cloud.

can provide limited protection and should be used in conjunction with firewalls.

A WELL-BEHAVED ROUTER

Your management-tool options range from command line console debuggers to Unix-based graphical SNMP packages. All three routers we reviewed can be managed from a central location. From gathering network statistics to upgrading the remote site's firmware, administrators can do it all without leaving corporate headquarters.

All of the routers we tested offer some statistics either through the management console or via a telnet session. Information about ISDN channel uptime, compression performance, and routing tables only scratches the surface of the data available on network behavior. Enterprise networks require a powerhouse—Unix-based HP OpenView or SunNet Manager. Vendors also provide their own optional PC-based SNMP management.

WHICH WAN DO WE WANT?

Three popular WAN choices are point-to-point private lines, frame relay, and ISDN. Traditionally, large companies have used point-to-point private lines. Telephone companies can provide private lines with data rates from 56 Kbps to T1 circuits at 1.54 Mbps. The monthly bill for point-to-point lines depends on distance, circuit speed, and local tariffing.

Point-to-point private lines provide a guaranteed high-speed connection. Subscribers usually use HDLC or PPP as the WAN protocol. Point-to-point also requires a dedicated interface. If you have a large number of remote sites, connecting them using point-to-point will cost more in hardware and monthly line charges.

With frame relay, PVCs are defined over the phone company's packet-switching system. You and other subscribers share the frame-relay network (or cloud). As the number of your branch offices grows, you simply purchase more PVCs; there's no need to add physical connections. The downside to frame relay is that everyone in the cloud also shares the network congestion. But frame relay has gained in popularity thanks to its low tariffing.

Integrated Services Digital Network (ISDN) is another option. But you'll need to be careful with ISDN's tricky tariffing. Much like a regular phone network, ISDN dials a phone number to establish its connection. ISDN is no bandwidth slouch: You can combine two B-channels for 128 Kbps. Depending on your provider, monthly charges can range from a flat fee to something that resembles your long-distance bill. You can use ISDN as a dial-on-demand connection, for batch transfers, or as a backup to a primary WAN link.

For starters, though, you have to understand your network and your needs completely before you can choose any of these routers or wide-area links wisely.

Bay Networks Inc.

BayStack Access Node Hub

ALL REVIEWS BY CHARLES LIN

No matter how technically experienced or inexperienced your branch office staff is, Bay Networks has a configuration method to suit your needs. We tested the 8-port BayStack Access Node Hub ($2,945) with the central-site Access Stack Node product and found both to be flexible in configuration and feature set.

Even if the remote site does not have a systems administration staff, initial installation can still be plug-and-play provided that the site is connected via frame relay or point-to-point and you use Wellfleet HDLC as the WAN protocol. Bay Network's EZInstall program configures the WAN interface, fetching the router's operating system and configuration file from a Bootp server at the central site. The OS and configuration file then can be saved onto the ANH's PC Card flash card, so future reboots can be done locally.

Bay Networks also provides Quick2-Config, a Windows program that lets you configure the ANH through a serial cable attached to a workstation. Quick2Config's GUI is easy enough to use for anyone familiar with the Windows environment. With a phone call to the central-site system administrator, any member of the branch office staff can get the router on the network.

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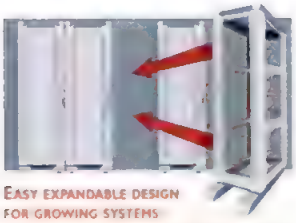

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Measure-UPS™ monitors NetShelter's environment even during power outages

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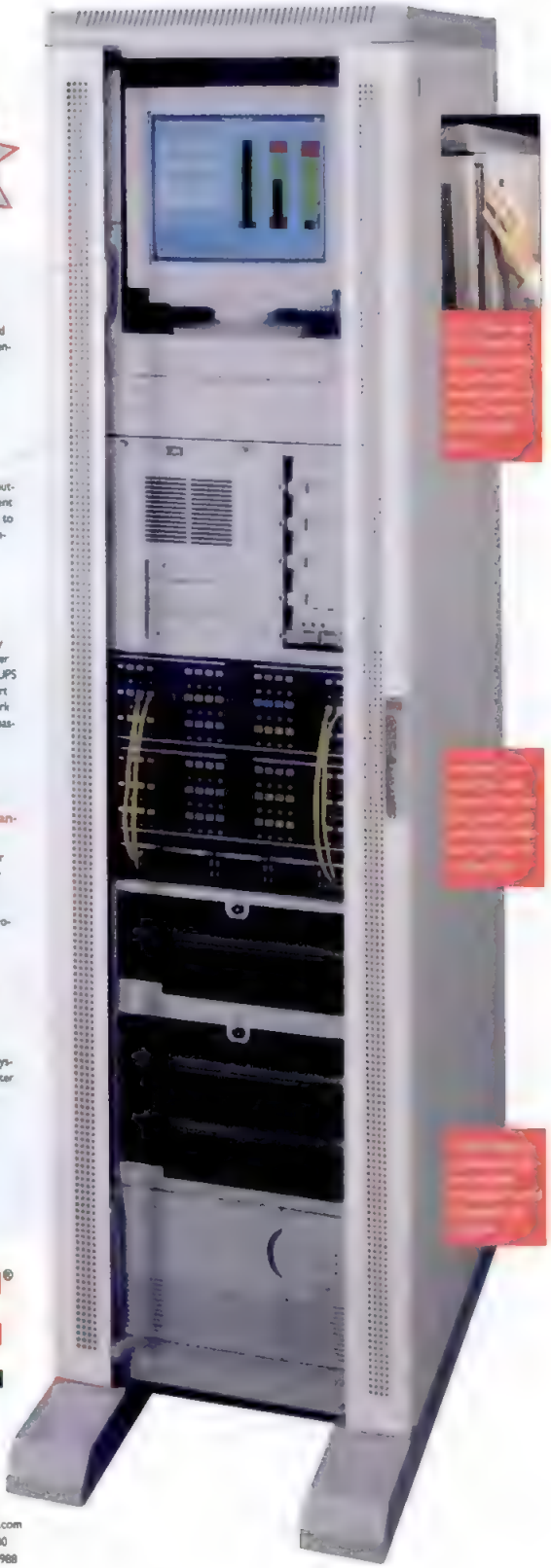


CIRCLE 915 ON READER SERVICE CARD

Optimize Your Wide-Area Connection

By Charles Lin

The single biggest bottleneck in any network is the relatively low-bandwidth WAN connection. Even a high-speed T1 link, at 1.54 Mbps, offers only a fraction of what your local network's 10-Mbps Ethernet offers. If your remote sites are connected over 64-Kbps frame relay or 128-Kbps ISDN BRI, you'll really appreciate the advantages of good data compression across your WAN.

To use compression well, you should understand how it is deployed and what types are available. Here's how compression is negotiated between two routers: If the two endpoints use PPP as the WAN protocol, they first must agree on the type of compression. PPP uses the Compression Control Protocol (CCP) to negotiate the compression type, algorithm, and dictionary size. Frame relay does not use CCP to negotiate the compression, but the two endpoints still need to have identical compression settings.

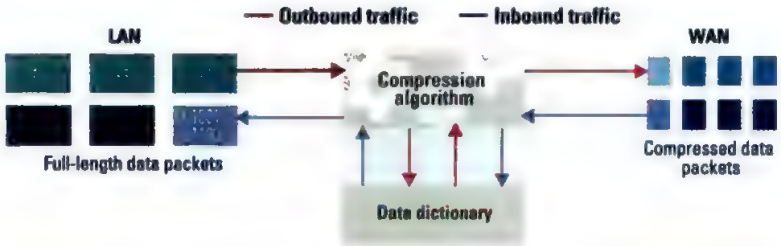
Once the negotiation is complete, it is the router's job to compress data by using a compression algorithm such as Stac's Stacker or Predictor. The router's processor power will play a part in the throughput, but the compression algorithm will determine the compression ratio. A fast processor may be able to give you a high throughput, but it's the algorithm that determines the bandwidth savings.

Compression also can be divided into packet-based and history-based. Packet-based compression uses a proprietary dictionary to replace patterns in the data portion of the packet with a token. A larger dictionary provides better overall compression. When the packet reaches the other endpoint, the router checks the dictionary and replaces the token with the equivalent uncompressed data.

History-based compression uses a managed dynamic dictionary. Any unfamiliar data portion is kept in the dictionary of both routers. When a duplicate packet is routed through the WAN, the dictionary replaces the packet with a token. History-based compression will dramatically reduce the amount of bandwidth wasted by broadcast packets.

How Compression Makes Better Use of Bandwidth

Compression can multiply your WAN's bandwidth significantly. Before a packet is sent to the WAN circuit, a compression algorithm uses a data dictionary to replace the data packet with a new smaller data packet. In order to use compression, both ends of the WAN must agree on the compression algorithm, dictionary type, and dictionary size.



PACKET FILTERS AND SPOOFING

In a large network environment of multiple servers and protocols, service broadcasts such as SAPs, watchdog packets, and even NetWare serialization packets can add up. On 10-Mbps Ethernet LANs, the problem isn't noticeable. But when these packets are forwarded through a 64-Kbps frame-relay link, excess traffic can translate into money wasted.

When a packet enters the router's Ethernet interface, the router reads the packet's subnet address, which tells the router whether the packet belongs in the local network. If it is the same subnet as the Ethernet interface, the packet is dropped. Otherwise the subnet is checked against the routing table and forwarded to the correct interface.

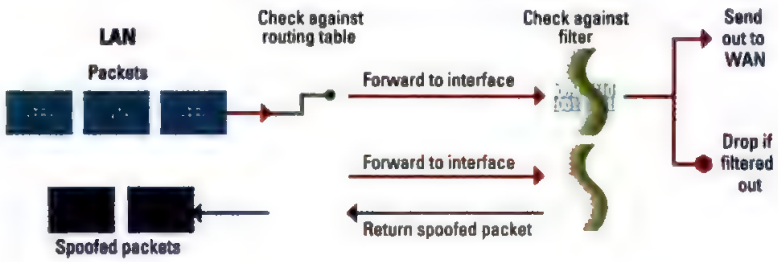
Once the correct route is determined, the packet is forwarded to the interface. In the case of a broadcast packet, the packet is distributed to every remote interface. Outbound filters at each interface intercept the packet and either drop it or spoof a response.

Filters also can be used to prevent network clients from detecting services. For example, by using filters the administrator can make servers invisible to selected subnets, thereby protecting sensitive data from curious users.

Implementing filters without careful planning can sometimes create havoc on your network. Filtering out broadcast packets or spoofing requests can block out changes in the network. If a server on your central network goes down, the remote stations still detect the server but are not able to gain access. An imprecise filter also might prevent your remote clients from seeing new services on the central network.

Filters and Spoofing

When a packet is routed from the local network interface (usually the Ethernet port of the router) to the WAN interface, a filter defined at the interface determines whether to forward, drop, or spoof a return packet. Preventing extraneous packets from wasting the WAN bandwith can help lower your monthly WAN expenses.



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yes NetWare

Network Management Comparison

	Configuration methods	System-image location	Configuration-file location	Plug-and-play WAN	Compression algorithm	Serial speed per port
BayStack Access Node Hub	Console, console script, Quick2Config (Windows-based), SiteManager	Bootp server, flash PC Card	Bootp server, flash PC Card	Frame relay, Wellfleet HDLC	WCP	6 Mbps
Cisco 2516	Console, console script, Config Builder (optional)	Flash ROM	Bootp server, flash ROM	Frame relay, HDLC	Stacker, Predictor	2 Mbps
3Com NETBuilder Remote Office 221	Console, console script, Transcend (optional)	Flash ROM	Flash ROM, NetBuilder II	Frame relay, PPP	Stacker	1.54 Mbps

An installation batch file provided by Bay Networks is another method for initial router configuration. Using a terminal attached to the console, the batch file configures the router by asking for the router's configuration details in plain English. When the initial setup configuration is complete, the router can be fully configured in two ways: via the console command-line interface or through Bay Network's Site Manager. Site Manager is an SNMP-based application whose Windows GUI is identical to the GUI in Site Manager's Unix version.

You can use Site Manager to configure the remote router dynamically, remotely, or locally. With dynamic configuration, changes take place immediately but are not saved on the flash card. This means administrators can try out different configurations before committing to one. Remote configuration changes the configuration file on the remote router's flash card.

With local configuration, administrators create configuration files at the central site. These files then are copied onto the flash card to be delivered to the remote site or stored on the Bootp server for EZInstall. Locally created configurations can be used as a template for multiple installations.

All Access Node products have two synchronous ports and a 4MB flash card. Our test Access Node Hub included an 8-port Ethernet hub, ISDN BRI, and an RMON data-collection module. Bay Networks provides three different router OSs, whose main differences are in network protocol support. The ANH can be purchased with IP support only or with the Corporate Office suite of AppleTalk Phase 2, DECnet, IP, IPX, Banyan's VINES, and Xerox XNS.

Its WAN support includes frame relay, Point-to-Point Protocol (PPP), HDLC, SMDS, X.25 and ATM DXI. For ISDN subscribers, the ANH has dial-on-demand functionality and multilink PPP. A user-set threshold will bring up the second B-channel for ISDN bandwidth-on-demand.

Bay Networks provides multiple methods for managing traffic across the WAN link. All ANH interfaces can be set with both inbound and outbound filters. Filters are created easily using Site Manager's predefined list of packet types and properties. Traffic can be prioritized for time-sensitive data. Bay Networks compresses data using the Lempel-Ziv algorithm and Telco System's Dictionary.

For large networks, Bay Networks provides optional Unix-based Optivity Internetwork or Windows-based Optivity EZ-Internetwork software. Both packages can configure the routers and collect RMON data. For mid-size networks, there's Windows-based Optivity Campus 6.0.

BayStack Access Node Hub. List price: $2,945; optional ANH ISDN Adapter module, $500. Bay Networks Inc., Santa Clara, CA; 800-822-9638; fax, 508-670-9232; http://www.baynetworks.com. *Circle 951 on reader service card.*

Cisco Systems Inc.

Cisco 2516

With so many configuration options and features, the Cisco 2516 is prime evidence of Cisco Systems' experience in the router market. The remote site router we tested was a fully loaded Cisco 2516, with ISDN BRI capability, a 14-port Ethernet hub, and two synchronous ports. It lists at $2,595. One continuing criticism of Cisco Systems is that it lacks a graphical configuration program. The many administrators experienced with Cisco products, however, will be comfortable with the Cisco 2516's configuration program.

Cisco's built-in AutoInstall procedure enables 2500 routers at remote sites to configure themselves automatically for frame relay or HDLC over the WAN interface. The routers then can retrieve the rest of their configuration files from a Bootp server located at the central site. Once the routers are connected over the WAN, the administrator can finish their configurations using a telnet session.

If the remote site is connected either point-to-point using PPP or via ISDN, an included batch file guides a user attached through the console port in creating a minimum configuration that will get the router attached to the WAN. The Cisco 2516 was the only router in this roundup to save the configuration files in ASCII. Administrators can edit the file easily using any text editor. A hard copy of the configuration can be kept for reference.

Although command-line interfaces generally involve a steep learning curve, Cisco's interface has some useful features that help users to recognize rather than memorize commands. The commands are grouped in a tree structure. When you begin to understand the logical groupings, everything falls into place. Cisco's powerful debugging features enable users to troubleshoot any problems with frame relay, ISDN, or point-to-point links.

The Cisco IOS operating system can be purchased with different sets of network protocol support. Along with the AppleTalk, IP, and IPX found in most routers, the IOS Enterprise set also supports DECnet, OSI, and Banyan's VINES. Routing protocols for large IP networks can be configured for OSPF, Cisco's proprietary IGRP, or Enhanced IGRP.

Cisco's dial-mapping gives an ISDN-connected remote router the ability to route directly to other ISDN-connected remote sites without passing through the central site. Packets with destinations at other remote sites trigger an event that establishes a direct ISDN call. Bypassing the central site saves time and money.

Making the best use of the WAN means keeping broadcast packets off the network. SAPs and watchdog keep-alive packets can waste precious bandwidth, and, in the case of ISDN, keep the line from tearing down. The Cisco 2516 can maintain hundreds of filters, customized to the bit level.

Cisco's Snapshot Routing is also an excel-

HOW WE TESTED

Remote Routers

We tested remote-site routers from Bay Networks, Cisco Systems, and 3Com to see how they perform in different environments. Remote-site routers may be simpler to deal with than central-site routers, but everything is relative.

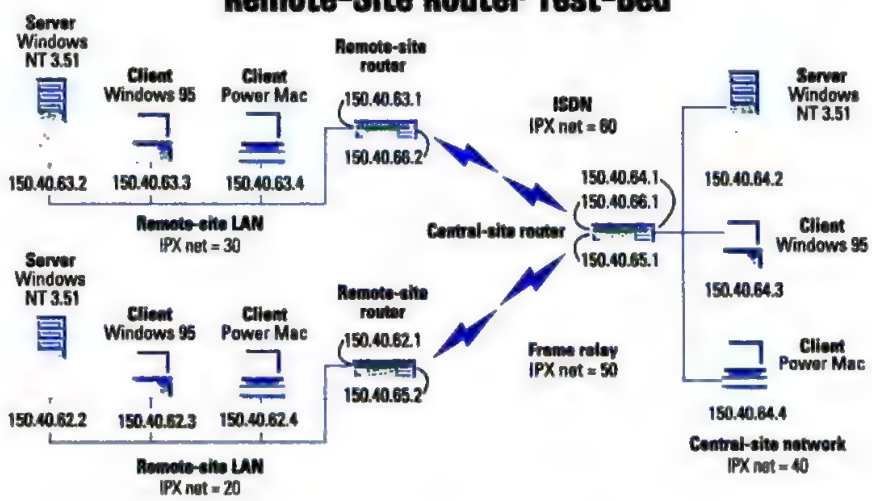
These remote routers have some nice features, such as graphical interfaces and quick-configuration screens. But routers are inherently the most complex devices on the network, because they must fully interpret all the different network packets on the wire. 3Com goes one step further: It actually uses smart bridging in place of routing technology at the remote site to simplify deployment and upkeep.

We tested these routers using a full range of network protocols, operating systems, and WAN connectivity options. We used Novell's NetWare and Microsoft Windows NT networking with the IPX/SPX, TCP/IP, and AppleTalk network protocols. We uncovered many nuances when testing the various protocol combinations. Our suspicions were confirmed: To use routers effectively, you must first understand your own network extremely well.

We set up a network with three popular types of WAN connectivity: Frame Relay, ISDN, and Point-to-Point. For the Point-to-Point link, we used an Adtech Model SX/12 Data Channel Simulator configured to run at 128 Kbps. We ran HDLC and PPP data links over this simulated digital circuitry. For the Frame Relay and ISDN connections, we used Pacific Bell production networks. To connect to the ISDN network, we used Northern Telecom DMS-100 switches at our simulated central office.

We tested each remote-site router only with the vendor's central-site router counterpart. We recommend this configuration for the smoothest, most complementary setup, running, and management.

Remote-Site Router Test-Bed



lent way to minimize traffic. Snapshot Routing keeps the routing table entries from expiring. If the remote site is connected to the central site via ISDN, the link can remain inactive for a long period of time. Once the link becomes active again, new routing information can reach the router and be stored.

To squeeze more out of limited WAN bandwidth, Cisco gives you a choice of Stac's Stacker or Predictor algorithms for data compression. The Cisco 2516 also can compress IP packet headers for a little bit of extra bandwidth.

Of the three products we reviewed, the Cisco 2516's security features were the most impressive. This router can be configured with 15 levels of user access. Security for ISDN connection is provided by PAP and CHAP authentication.

The remote site can be managed at the central location using Cisco's SNMP-based management packages. For the PC, there's Cisco Works with Windows ($2,495), which includes two applications: Configuration Builder and Cisco View.

Cisco 2516. List price: $2,595. Cisco Systems Inc., San Jose, CA; 800-553-6387, 408-526-4000; fax, 408-526-4100 http:// www.cisco .com; *Circle 952 on reader service card.*

3Com Corp.

NETBuilder Remote Office 221

At the low end of the 3Com NETBuilder line of routers is the ultimate in plug-and-play remote-site routing. The NETBuilder Remote Office 221 ($1,995) is perfect for a small branch office.

The Remote Office 221 comes equipped with a single Ethernet interface and two synchronous serial ports. The synchronous ports can be configured as one primary WAN link and one backup WAN link with T1-equivalent bandwidth. The Remote Office 221 is designed for small offices using IP, IPX, or AppleTalk protocols.

The key to the Remote Office 221's ease of deployment is Boundary Routing, a 3Com proprietary technology. Boundary Routing extends the network from the central site to the remote site, bridging WAN interfaces. Using a NETBuilder II at the central office, a virtual interface is created that starts at the WAN interface of the central site and extends to the Ethernet interface of the Remote Office 221.

The Remote Office 221's job is to forward packets with destinations outside the local subnet to the WAN interface. If the WAN link is frame relay or point-to-point, Remote Office 221 will be able to auto-con-

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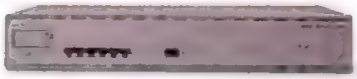

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figure the router without human intervention. Unlike the other products in this roundup, the Remote Office 221 does not require a Bootp server for its configuration.

A few quick commands at the NETBuilder II allowed us to create a virtual interface for the Remote Office 221. The virtual port enables the remote router to obtain its IP address through an inverse ARP command. Although assigning IP to the Remote Office 221's Ethernet interface is not a prerequisite for the router to work, the interface allows the router to be configured from the central site and enables some of the router's SNMP-based features.

To prevent the WAN from being bogged down by forwarded packets, 3Com created a technology called Smart Filter. The NETBuilder II observes the traffic over the virtual port and creates appropriate traffic filters. The filters then are transported to the Remote Office 221 using the SNMP implementation. The Remote Office 221 router can also store custom filters.

BOUNDARIES

Although Boundary Routing is an excellent way to connect your remote office, we encountered a couple of problems in our testing. If the remote site does not have a local server on the LAN, it can take several minutes for the remote-client stations to find a server on the central network.

During testing, the Windows 95 client timed out when it tried to log on to a Window NT Domain server on the central site. Skipping domain authentication and logging onto servers as needed is the workaround. Turning on compression and using a point-to-point connect also helps. 3Com is aware of the problems and is supplying its customers with workable solutions.

Although configuring the Remote Office 221 router through the console port is possible, it is probably best avoided because the command structure is not very intuitive. The commands can be accessed through a menu, but the menu options are not arranged in any logical order.

Menu lists often take more than a single screen, and the entire list must scroll by before the user can choose a command. The best way to interact with the command-line interface is to use a combination of memorized commands and menu selections.

If the Remote Office 221 router is not able to configure itself during boot-up, it automatically launches a configuration batch program to guide the console user through an initial configuration. The Remote Office 221 can be configured via SNMP using the Transcend application. 3Com believes SNMP-based configuration to be undesirable because of SNMP's lack of security.

Although the Remote Office 221 can be configured for either history-based or per-packet-based compression, 3Com recommends using the former, because, although its processing overhead tends to reduce throughput, it uses the bandwidth more efficiently. During testing, we found per-packet-based compression to result in faster throughput, but history-based compression achieved a higher ratio. 3Com licenses Stac's compression algorithm for its NETBuilder products.

3Com's Remote Office products can be managed using 3Com's Transcend management package. Transcend is available for $3,495 on Windows, $4,000 on SunNet Manager, and $9,495 on HP OpenView and NetView/6000 platforms. □

NETBuilder Remote Office 221. List price: $1,995. 3Com Corp., Santa Clara, CA; 800-638-3266, 408-764-5300; fax, 408-764-5301; http://www.3com.com. *Circle 953 on reader service card.*

SUMMARY OF FEATURES

Remote-Site Routers

PC MAGAZINE NETWORK EDITION EDITORS' CHOICE

■ YES ■ NO

Products listed in alphabetical order

	Bay Networks Inc. **BayStack Access Node Hub**	Cisco Systems **Cisco 2516**	3Com Corp **NETBuilder Remote Office 221**
List price of tested configuration	$3,445	$2,595	$1,995
Processor	Motorola 68360	Motorola 68EC030	Motorola 68302
Flash ROM	8MB	16MB (tested configuration	4MB
Flash card	4MB or 8MB	None	None
List price of operating system	IP Access Suite 4MB, $350; 8MB $850 Remote Office Suite 4MB $750; 8MB, $1,250 Corporate Suite 4MB, $1,850, 8MB, $2,350	IP only, $1,200; IP/IPX, $1,600; desktop option, $2,200; enterprise option, $3,100	Included
WAN			
Number of serial ports	2	2	2
Serial speed per port	6 Mbps	2 Mbps	1.54 Mbps
Supports frame relay/PPP	■ ■	■ ■	■ ■
Supports HDLC/SDMS	■ ■	■ ■	■ ■
ISDN BRI	■	■	■
LAN			
Ethernet ports	10	14	1
RMON	■	■ (software only)	■
Router Configuration Method			
Console	■	■	■
Script	■	■	■
Windows utility	■	■	■
Supported IP Services			
Bootp	■	■	■
FTP	■	■	■
Telnet	■	■	■
Supported Network Protocols			
IP	■	■	■
IPX	■	■	■
AppleTalk	■	■	■
DECnet	■	■	■
VINES	■	■	■
XNS	■	■	■
SNA	■	■	■
Compression			
Algorithm	WCP	Stacker, Predictor	Stacker
Header	■	■	■
Payload	■	■	■

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Automatic network connection from the road or office (IP Switching)	YES	NO	NO
High-speed connectivity to anyone, anywhere (ISDN, X.25, CDPD)	YES	Partial	NO
Dynamic network connectivity with automatic router discovery and router fallback	YES	NO	NO
Advanced network troubleshooting tools keep you connected	YES	Partial	YES
Automatic scripting allows easy, one-click access to your most frequent connections	YES	NO	NO
Protects valuable data with Internet firewall support for your PC (SSL, SOCKS, ANS, others)	YES	NO	NO
Increases desktop flexibility by allowing you to run Netware applications over IP	YES	NO	YES
Seamlessly coexists with other enterprise networks (NetBIOS, Vines, IPX/SPX)	YES	NO	YES
Single vendor for host access, resource sharing, transport, Internet client and server with a worldwide sales and support organization	YES	NO	Partial

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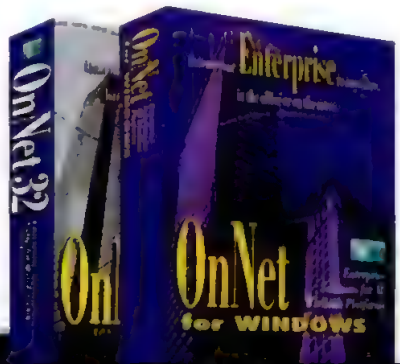

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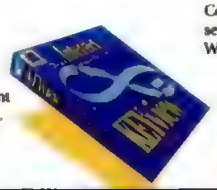

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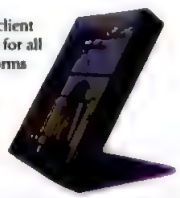

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CIRCLE 877 ON READER SERVICE CARD

First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

ISDN ROUTERS

It's a Smooth Integrator

By Les Freed

If the word *router* conjures up visions of complicated configuration screens, constant parameter tweaking, and intermittent, inexplicable communications problems, then Shiva Corp. wants to show you a little something: the $1,299 Shiva Integrator 100. It's a single-BRI-line ISDN router in a neat, tidy, easy-to-install box. It's designed for small-, home-, and branch-office installations that require on-demand, high-bandwidth connections to another (usually larger) LAN. It can route IP or IPX protocols, and it can route both on the same network.

The Integrator 100 is about the size of a closed laptop, only a little thicker. The simple front panel hosts four large status LEDs. The equally simple rear panel hosts connections for an ISDN line, a 10Base-T connection, an RS-232 configuration port, an AC power connector, and an on/off switch.

Installing and configuring the Integrator 100 on an IPX network couldn't be simpler. First, you connect a PC with a VT-100 emulator program to the serial port via the supplied RS-232 cable. Any Microsoft Windows–based laptop will do. Power up the Shiva, type "install", answer a few questions, and you're done.

You'll need to know your ISDN phone numbers and SPIDs as well as the IPX LAN address of your server and the Ethernet address of the remote Shiva unit. We had the Integrator 100 up and running about 10 minutes after opening the box.

This product's small size belies its big performance. In informal testing, the Integrator 100 held its own with similar products from Ascend and Symplex. When used as an IPX router, it provides enough punch to make remote users feel they're connected directly to the main LAN. Small-file copy and directory search operations happen almost immediately, but large-file open and copy operations are noticeably slower than Ethernet speeds.

Because the Integrator 100 handles the IPX to ISDN conversion process, your remote PCs don't need any special software. They do need an Ethernet card and IPX protocol stack, just as they would if they were directly connected to the main LAN. If you're planning to install more than one workstation at each remote site, you'll also need an Ethernet hub at each site.

Because it's an external router, the Integrator 100 places no resource demands on your existing LAN servers. You just plug it into the LAN and run the configuration software.

The Integrator 100 can communicate with another of its own kind on either of the two ISDN B channels or on both. It can even communicate with two other Integrator 100s simultaneously by talking to different routers on the two B channels. If your needs outgrow the point-to-point capabilities of the Integrator 100, Shiva makes the Integrator 500 ($11,999), which provides two ISDN PRI interfaces. Each PRI line provides 23 B channels, allowing the Integrator 500 to connect as many as 46 remote users at once.

In most parts of the country, ISDN service is charged by the minute. Although individual minutes aren't expensive—usually only a penny or two—they do add up. The Integrator 100 uses various techniques to minimize connection times.

Continues on page NE22

PHOTOGRAPHY BY THOM O'CONNOR

GATEWAYS

cc:Mail, Web-Style

By Padraic Boyle

With its new gateway software package, cc:Mail for the World Wide Web 1.0, Lotus Development Corp. takes cc:Mail to the Internet. This package provides most of the capabilities that desktop cc:Mail users have to remote-site cc:Mail users who have Internet access. The biggest difference is that users view mail with a Web browser instead of with the cc:Mail interface.

Though you're using the Internet, cc:Mail for the Web is merely a mail front end to cc:Mail; it doesn't give you instant Internet mail. A separate SMTP gateway must be purchased for those capabilities.

cc:Mail for the Web ($159) is a gateway software package that runs on a Microsoft Windows NT–based Web server with network or local access to cc:Mail post offices. Depending on your network configuration, there are Web server issues to consider: Users must be able to access the server across the Internet, which may take some modification if a firewall is involved. And to operate cc:Mail for the Web, the Web server must have access to one or more cc:Mail post offices.

As for the client side, a Web browser that supports HTML 2.0 is all you need. Users can be anywhere in the world; as long as they have Web browsers and Internet access, they can get to their mailboxes. Users can read mail, delete old messages, com-

Continues on page NE24

Shiva Integrator

Continued from page NE21

Like most routers, the Integrator 100 brings the ISDN link up when there's traffic on the LAN and drops the link after a user-definable period of inactivity. It has RIP and SAP spoofing, commonly used to prevent routing information and server broadcasts from needlessly bringing up the link.

The Integrator 100 also has a time-based Tariff Management scheduler that can limit ISDN usage during certain times. This feature can be used to limit the amount of time a given remote unit can spend on ISDN services; it can also be used as a security tool to prevent off-hours access to the LAN.

Other nice touches include remote administration via telnet, full SNMP support, support for PPP clients with PAP and CHAP authentication, Caller ID support, and a built-in AC power supply that doesn't require an external transformer.

Our sole complaint about the Integrator 100 is that the test units provided each had an S/T ISDN interface, which requires the use of an external NT-1 line interface. Shiva informed us that it is working on a U interface version, which should be ready by the time you read this.

Shiva Integrator 100. List price: $1,299. Shiva Corp., Burlington, MA; 800-977-4482, 617-270-8300; fax, 617-270-8599; http:\\ www.shiva.com. *Circle 955 on reader service card.*

CROSSTALK

Frank Derfler

"Shiva was a pioneer in the remote-node server market, but it took them a while to get into ISDN. Meanwhile, competitors like Ascend and Gandalf shouldered into the market. The original version of this product shows its European roots in the lack of an NT-1, but it's only the first in a line of new Shiva products, including multiline systems, designed to hold onto market share."

Gail Shaffer

"Small routers like the Integrator 100 are great for linking LANs using IPX, but they work well for multiuser Internet and intranet access using IP, too. If you use a router for Internet access, you'll have to negotiate an IP subnet address with your access provider. These types of products are now right for any office with two or more nodes. Use them instead of separate ISDN terminal adapters for every desktop."

ISDN ROUTERS

Farallon Offers ISDN Routing with Netopia

By O. Ryan Tabibian

ISDN has always held the promise of high bandwidth at a low price, but for years it has been just a promise. Certain factors, however, are combining to make ISDN a viable connectivity option. Two of the biggest factors are the rush for fast Internet connectivity and the increased availability of ISDN from the phone companies. And Farallon Computing, with its recently released Netopia Internet Router, is one of the many companies ready to help people procure and manage their new ISDN connections.

The Netopia is part of the flurry of ISDN products now coming to market. These products range from routers to basic terminal adapters, and all of them promise to simplify ISDN connectivity. The Netopia, however, manages to deliver. Not only is it easy to use, but it also offers features to satisfy the most demanding ISDN user.

The Netopia also has excellent management options. It is one of the only ISDN routers we've seen that has built-in Dynamic Host Configuration Protocol (DHCP) support, which simplifies IP address management.

Using DHCP, you can define a range of IP addresses on the router that are automatically assigned to workstations running DHCP-compliant clients. This eliminates the need to configure individual IP addresses at each workstation on the network, which can be a logistical nightmare to say the least.

The Netopia was designed to be used primarily for direct connections to an Internet service provider (ISP). It can also, however, serve as an excellent remote-site router thanks to such features as dial on demand and schedule connections. These features allow you to determine when the router automatically establishes the connection.

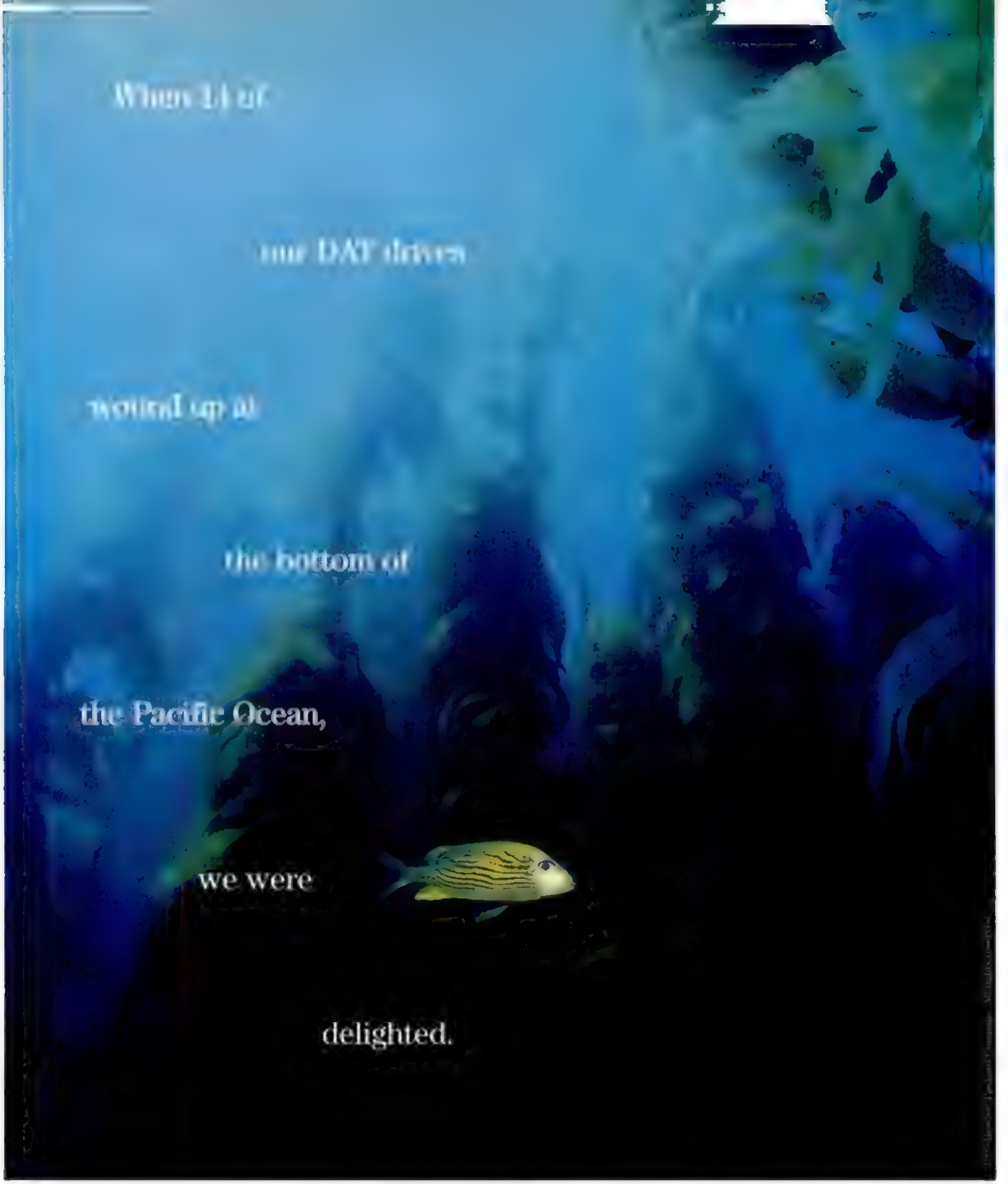
To test how functional and easy to use the Netopia was, we installed two units in our Labs. We were impressed with the simple interface: It made configuration and management a snap. We had the product up and running in less than an hour. The process includes connecting the provided RS-232 cable to the PC's COM port and accessing the routers configuration menu using terminal emulation software.

Once connected, the intuitive menus walked us through the installation processes—entering the SPID number and configuring the IP interface, for example—step by step. Even though the interface was text based, we were impressed with its well-organized menus and simple configuration options. But we would like to see Farallon add a graphical configuration utility to simplify management for end users who may not be comfortable with traditional router configuration menus.

For those users weary of dealing with SPID numbers and arcane ISDN commands, Farallon offers an optional service that is called Up and Running Guarantee ($495 a year). If you purchase this option, Farallon will take full responsi-

Continues on page NE24

CONNECT IT: *The management options in the Netopia are outstanding, particularly the DHCP support.*



5,000 meters below the sea: scientists rely on HP DAT drives to record earthquakes.

The course of true research doesn't always run smooth (or dry). Ask any of the scientists at Scripps Institution

HP SureStore

of Oceanography who engineered a pioneering study of earthquakes—at the bottom of the sea. The plan was to deploy seismometers across the highly unstable oceanfloor east of Fiji and Tonga to measure the earth's motion for a record three months straight.

There was just one catch. Scripps needed DAT drives that could backup such huge amounts of data, unattended. And that could function reliably in an underwater world of near-freezing temperatures, volcanic eruptions, and frequent earthquakes. So naturally Hewlett-Packard was honored (though hardly surprised) when our SureStore Tape Drives were chosen to take the plunge.

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First Looks

cc:Mail

Continued from page NE21

pose and send new messages, and access folders. In addition to the Internet, cc:Mail for the Web will operate in corporate intranet environments.

cc:Mail for the Web is simple to use, but not all functions found in the standard cc:Mail package are available. cc:Mail for the Web doesn't support off-line reading and composing features, it can't send file attachments, and it doesn't have return-receipt functionality. This limits you to the e-mail basics: reading, composing, sending, and forwarding mail. And cc:Mail for the Web is available only on a Windows NT Web server platform.

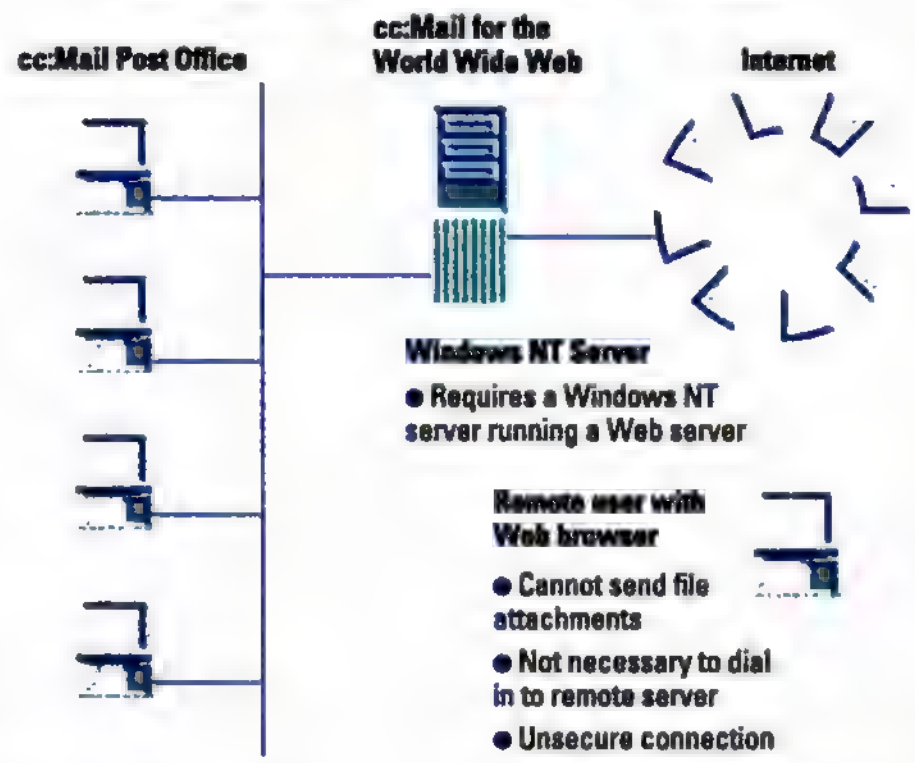
Our test configuration consisted of an HP NetServer 5/66 LF server with Windows NT 3.5 and Netscape's Commerce Server, Version 1.1. We ran an HP Vectra 5/90C with Windows 95 and Netscape Navigator 2.0 installed on the client. The server and client were connected using 10Base-T to simulate a remote, albeit high-speed, network connection.

We ran into a few minor problems during installation, all of which we solved after modifying a configuration file on the Web server. The configuration file, which contains file locations and post office paths, can only be edited with a text editor. Once configuration was complete, we easily gained access to our mailbox.

After you install the software, access to cc:Mail for the Web is available at a predetermined address. A Home Page requesting a Name and Password is presented to the client in a standard HTML form. After inputting valid names and passwords, users have full rights to their cc:Mail mailboxes, including all folders.

The user interface offers links to other functions of cc:Mail for the Web that are similar to the way a typical Web page operates. Forms are used to compose, send, and forward mail. If necessary, the user interface can easily be translated into five languages, including French and German, by simply selecting the language during log-on.

cc:Mail Delivers via the Web



In addition, Lotus offers other gateway products, such as cc:Mail SMTP Gateway and cc:Mail to UUCP, that allow users to send and receive mail on the Internet via cc:Mail.

cc:Mail for the Web allows you to address mail to other users in the address book by typing in the name of the user. You can't view the address book, however; you must know the address you're inputting. But Lotus does offer a search function that lets you look up a user by name in the cc:Mail database.

cc:Mail for the World Wide Web 1.0. List price: $159. Lotus Development Corp., Cambridge, MA; 800-346-1305; 617-577-8500; http://www.lotus.com. *Circle 954 on reader service card.*

Netopia

Continued from page NE22

bility for configuring and establishing the necessary connections for you.

On the hardware side, the Netopia comes with a single ISDN port, two RJ-45 Ethernet ports, a built-in NT-1 interface, and even PC Card slots so you can install modems for remote management of the device. Farallon has stayed true to its Macintosh roots by including both a LocalTalk port and AppleTalk routing in the Netopia.

The router also features multilink Point-to-Point Protocol (PPP), which allows you to use both 64K data channels on the ISDN line to transfer data simultaneously. In the past, most ISDN products were able to take advantage only of a single data channel, thereby limiting throughput considerably.

The Netopia sports an impressive design and provides a slew of useful LEDs to keep you abreast of the router status, ISDN channel status, and network traffic.

The Netopia also comes bundled with a host of applications to simplify Internet connectivity: Qualcomm's Eudora Internet mail reader, Netscape Navigator, and telnet and FTP utilities.

In sum, the combination of features and ease of use makes the Netopia Internet Router an excellent choice for anyone looking to connect their LAN to the Internet.

Netopia Internet Router. List price: $1,399. Farallon Computing Inc., Alameda, CA; 510-814-5100; fax, 510-814-5025; http://www.farallon.com. *Circle 956 on reader service card.*

RAID SYSTEMS

Renegade Opens the Gate

By Eric Harper

At around 70 cents per megabyte of storage, the Renegade RAID System from MountainGate Data Systems is a flexible, high-capacity storage solution offering fault-tolerant data protection. It also happens to be competitively priced. The Renegade has many crucial features, such as an auto-rebuild function, optional removable drives, and support for RAID levels 0, 1, 5, 6, and 7, with support for level 3 due out later this year. And the Renegade provides network managers with a superb solution for increasing storage capacity by offering up to 42GB of storage.

The Renegade, however, lacks some useful features that other RAID systems offer, such as tape backup and SNMP management. MountainGate says these features and others will be added within the year, so you may do well to wait until Renegade is upgraded. Or you can contact MountainGate for planned upgrade costs.

But we couldn't argue with the solid performance of this unit. We tested a Renegade with five 4GB drives, for a total of 21GB of storage, on a PCI Pentium with DOS, Windows 95, Windows NT, and NetWare 4.1 without a hitch. We pulled drives from the array during heavy network access and during the rebuild process. We pulled the hot-standby drive at the same time as an array drive. No matter

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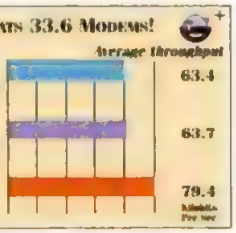

In addition to the performance features of OPTIMA, the Hayes Century 2 now offers an SNMP management agent that works with all SNMP-compliant network management software. Hot swapping insures minimal downtime. Backed up by Hayes' legendary support and service, Century 2 is the right choice when speed and reliability are crucial.

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what we tried, the Renegade kept humming along.

The Renegade, which supports Mac, PC, Sun, and SGI workstations, has room for 10 drives, hence the 42GB of storage. You can install the drives in any of the 10 open slots; however, the slots are arranged in two SCSI channels. MountainGate suggests dividing the drives between the channels for best performance. They will be adding support for two internal controllers later this year.

The drives support fast-and-narrow SCSI-2 or fast-and-wide SCSI-2 and offer data transfer rates of up to 20 MBps. And to enhance performance further, the Renegade provides up to 32MB of internal cache. Other fault-tolerant features include three ventilation fans, two load-sharing power supplies, and internal monitor programs that alert you when something is wrong.

With the drives installed, you are ready to define your array (or arrays). Rather than dedicate the whole system for one array, the Renegade lets you use the drives however you wish, even if it means creating multiple arrays.

For example, if you had six drives, you could take two and mirror them, then create a RAID 5 array with the remaining four. Each array has its own LUN for use by the host computer.

But you don't have to use all of the drives for an array. The Renegade lets you specify one drive as a hot backup. That way if any drive fails, the backup drive will automatically take over. When you replace the failed drive, it becomes the hot backup.

Defining arrays is accomplished through the menu system on the Renegade itself. There is a three-line LCD underlined with five buttons to navigate the menus and utilities. In case using the LCD display seems awkward, you can manage the system by attaching a terminal to the RS232 jack on the back of the Renegade unit. We loaded ProComm on a notebook, hooked it up, and found it worth the trouble.

You can also configure the RAID system to suit your needs best through the menu. Configurable parameters include automatic rebuild management, fault management, controller read-ahead functions, and stripe size. The documentation describes these parameters and explains the conditions under which you might want to change them.

The Renegade's documentation is adequate for physically installing the disk subsystem and configuring the arrays. As for getting the OS to access the drive and your SCSI controller to work with the rest of the components in the server, you're on your own.

An option you may be interested in is the ability to add up to two MountainGate IncreMeg drives in addition to the 10 RAID drives. The IncreMeg is a removable drive, completely encased in a sealed cartridge.

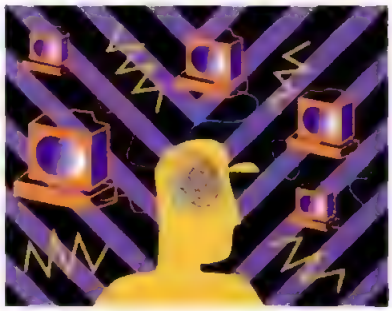
You can purchase IncreMeg docking stations for other computers on your network. To transfer data to your host quickly, plug the IncreMeg drives into the Renegade. Or you can use these drives to upload data to or download data from the RAID system.

Renegade RAID System. List price: With 42GB of storage, $30,000. MountainGate Data Systems Inc., Reno, NV; 800-556-0222, 702-851-9393; http://www.mountaingate.com/. *Circle 957 on reader service card.*

MULTIPLE ACCESS By Steve Buehler

Toasted or Fried?

When your electrical contractors set up the power in your building, they followed the specifications of the National Electrical Code. So all your outlets are grounded, your hot and neutral are correct, and everything you plug in to a receptacle should work just fine. Right?



Not necessarily. The same copper network you use to send data between PCs can carry electrical current as well. It's possible, and even likely, that your departments or workgroups are plugged into different power transformers. If those transformers aren't grounded to the same reference, electricity can leak between your workstations with some spectacular results. If you have paid a lot of attention to your network topology but only a little to your network power, you may be facing some serious problems.

The Institute of Electrical and Electronics Engineers (IEEE), a major standard-setting body, has some rigorous electrical requirements. It published *Powering and Grounding Sensitive Electronic Equipment* ($63.50, 800-678-4333) to describe recommended wiring and testing practices. But many electricians aren't aware of the specific steps in this guide and your network may suffer for it.

One company, American Power Conversion (800-800-4272), has a service to check out your premises and make sure everything is up to IEEE specs. The first step in the analysis is called Break Fix. For $1,999, an APC engineer shows up at your site, analyzes the specific problem, and delivers a list of corrections you can hand to your electrician. This may include recommendations for cabling, isolation, wiring changes, or installation of specific power-protection equipment.

A Capacity Audit ($3,999) is a whole-site inspection that can help you identify potential problems. This is great both for companies planning buildouts of new sites and for those nervous about their current cabling schemes. Since APC engineers truly understand networking hardware and cabling, even such small details as current looping through serial lines are explored and addressed in the hefty site report.

There isn't much competition for this service. Utility companies will do a power quality analysis for several hundred dollars and show you that they're delivering good power to your building. For about $25,000, your power company will provide continuous monitoring of the power in your building, but that misses the point. Your electrician or a UPS vendor can come on site and recommend specific fixes for known problems, but they usually can't help with planning for network growth and expansion. If you're looking to ensure that your network carry only data and not electricity that can damage your expensive hardware, consider that a Power Audit may be the only thing between you and that acrid smell of freshly toasted NICs.

ILLUSTRATION BY PETER COATES

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HAWK 2XL	ST32155	2.147 GB	Ultra SCSI 8/16 bit	up to 40 MB/sec	5411	9/10.5
HAWK 2XL	ST31055	1.050 GB	Ultra SCSI 8/16 bit	up to 40 MB/sec	5411	9/10.5

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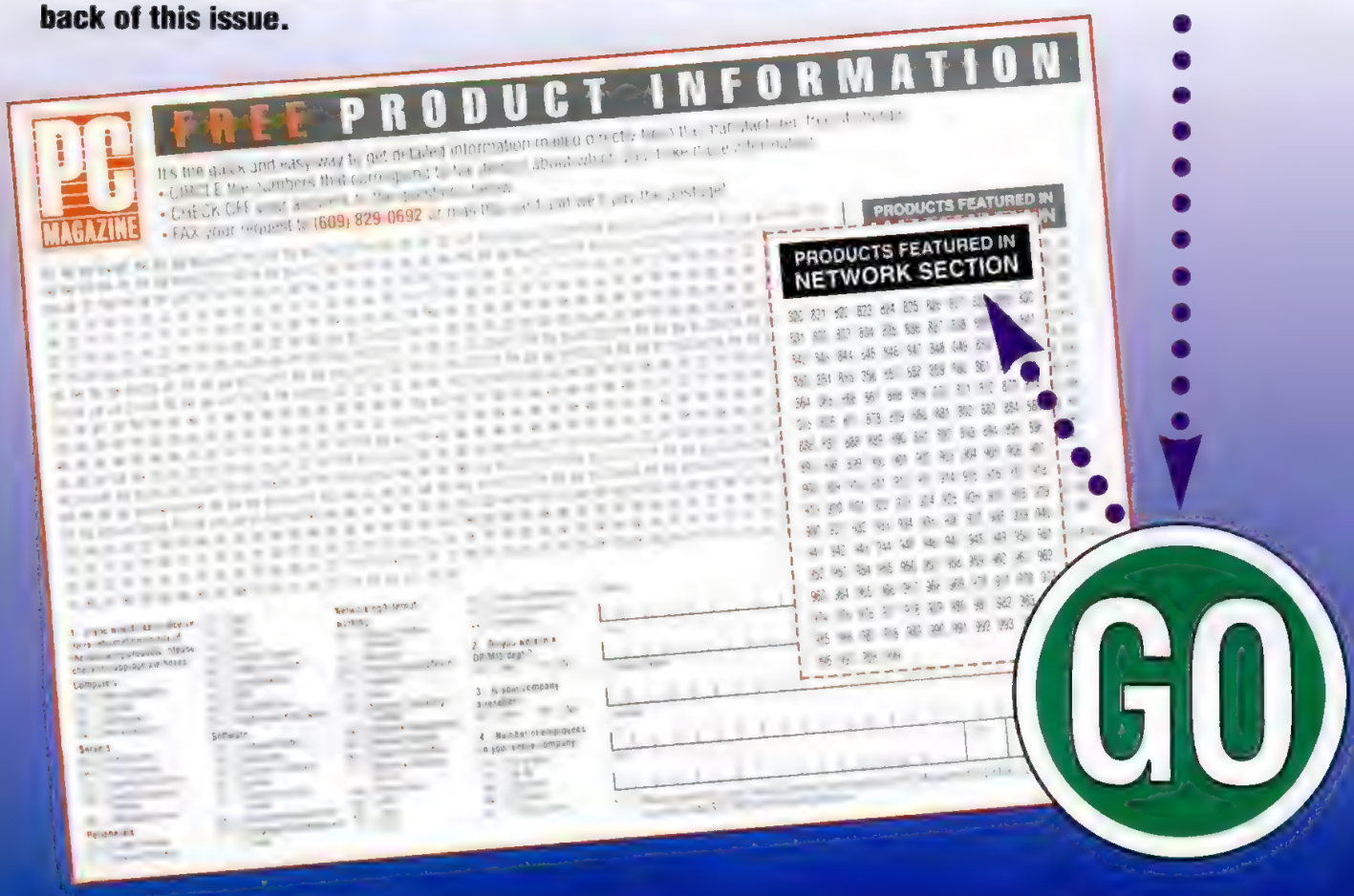

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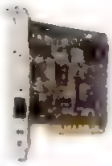

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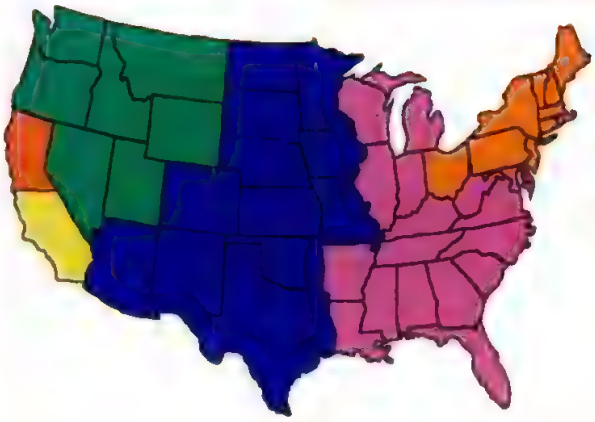

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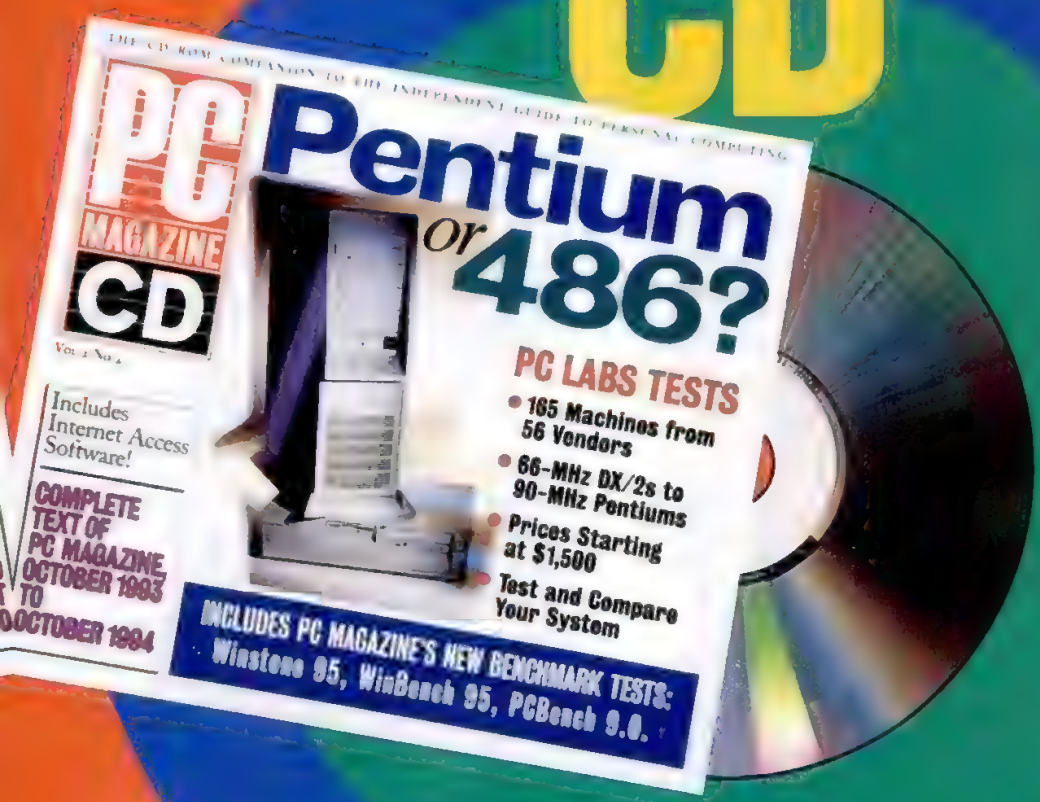

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Beyond the Pentium

Intel's top challengers have reached the Pentium level, but do they pose a threat to the king of the CPU hill? We examine the chips and the vendors to find out.

By Michael Slater

Over the past 18 months, the PC industry's rapid transition from the 486 to the Pentium has further entrenched Intel's position as the dominant supplier of PC microprocessors. As AMD, Cyrix, IBM Microelectronics, SGS-Thomson, and Texas Instruments tried to make ends meet while selling ever-cheaper 486 parts into a market that wanted Pentiums, NexGen struggled to find a market for its 586.

After many months of delay, Intel's top challengers, AMD and Cyrix, have finally moved up to the Pentium level. But given the wide range of designs and the convoluted naming schemes, sorting out the mix of products can be confusing. To understand today's and tomorrow's Pentium-class microprocessors, we need to look beyond the chip names, which no longer mean much. We need to look inside the chips to make sense of the technology and inside the companies making them to comprehend the business and marketing strategies that led to their development.

5x86: LAST GASP OF THE 486

AMD and Cyrix have both been selling devices called 5x86. Both the AMD and Cyrix chips plug into a 486 socket and deliver low-end Pentium performance. These chips are designed to fit into existing 486-based system designs, providing a performance boost to these least expensive PCs. Both companies chose the 5x86 name to conjure up a fifth-generation image while distinguishing their chips from NexGen's; chips with 586-like names sell far better than those with 486-like names regardless of the underlying

AMD 5K86 (K5)

Clock speeds: 75 and 90 MHz (Pentium-pin-compatible)
P Rating*: Same as clock speed
Cache memory: 16K instruction, 8K data
Design style: Four-issue RISC core
Transistors: 4.3 million
Die size: 181 mm^2 (0.35-micron)
Price (in lots of 1,000): 75-MHz CPU, $75, 90-MHz CPU, $99
Up next: Enhanced 5K86 (3Q 96), K6 (1Q 97)

Cyrix 6x86 (M1)

Clock speeds: 100 to 133 MHz (Pentium-pin-compatible)
P Rating*: 120, 133, 150, 166
Cache memory: 16K combined instruction/data
Design style: Flexible two-issue superscalar
Transistors: 3 million
Die size: 204 mm² (0.65-micron)
Price (in lots of 1,000): 100-MHz CPU, $199, 133-MHz CPU, $579
Up next: M2 (1Q 1997)

Intel Pentium Pro (P6)

Clock speeds: 166 and 200 MHz with 512K L2 cache; 150, 180, 200 MHz with 256K cache
P Rating*: Not applicable
Cache memory: 256K or 512K L2 cache on-board
Design style: Four-issue RISC core
Transistors: 5.5 million for CPU, 15.5 million for 256K L2 cache
Die size: 196 mm² (0.35-micron)
Price (in lots of 1,000): 150-MHz 256K-cache CPU, $804, 200-MHz 512K-cache CPU, $1,528
Up next: Klamath (1H 97)

IBM 6x86 (M1)

(same as Cyrix 6x86)
Clock speeds: 100 to 133 MHz (Pentium-pin-compatible)
P Rating*: 120, 133, 150, 166
Cache memory: 16K combined instruction/data
Design style: Flexible two-issue superscalar
Transistors: 3 million
Die size: 204 mm² (0.65-micron)
Price (in lots of 1,000): 100-MHz CPU, $185, 133-MHz CPU, $590
Up next: Cyrix M2 (1Q 97)

Intel Pentium (P5)

Clock speeds: 75 to 166 MHz
P Rating*: Same as clock speed
Cache memory: 8K instruction, 8K data
Design style: Limited two-issue superscalar
Transistors: 3.2 million
Die size: 91 mm² (0.35-micron)
Price (in lots of 1,000): 75-MHz CPU, $106, 166-MHz CPU, $632
Up next: 200-MHz CPU, P55C with MMX (4Q 96)

*The P Rating indicates a CPU's performance relative to that of an Intel Pentium CPU. A P Rating of 133 means that the CPU performs on a par with a Pentium/133

PHOTOGRAPHS BY THOM O'CONNOR

technology. While these chips offer low-end fifth-generation performance, both internally and externally they look more like enhanced fourth-generation designs.

Internally, however, the AMD and Cyrix chips are quite different. AMD ran into delays developing its 5K86 (code-named K5), which is its real Pentium competitor. Needing something to sell in the meantime, AMD decided to boost its 486 line to fill the gap until the 5K86 was ready. AMD's 5x86 is simply a 133-MHz 486DX4; it delivers performance comparable to a Pentium/75 but needs to run at the higher clock rate, because its CPU core is less efficient than a Pentium's.

5x86 designs will have a short life: Pentium-pin-compatible CPUs will win in the long run.

Cyrix's 5x86 is not based on the vendor's 486 CPU: It's an entirely new design—essentially an enhanced 486-type processor, borrowing a few tricks from Cyrix's 6x86. Because it is more efficient than any 486 but not as good as the Pentium in terms of performance per clock cycle, it can deliver Pentium/75-class performance with a 100-MHz clock. A 120-MHz version is comparable to a Pentium/90. But both 5x86 designs will have a short life span; neither company expects to pursue these products much past this summer.

CYRIX 6x86 LEADS THE PENTIUM CLASS

Although 5x86 chips with 486 pinouts do fill a gap, it is Pentium-pin-compatible devices that stand to gain some longer-term market share: Cyrix's 6x86 and AMD's 5K86. Both use internal designs somewhat more sophisticated than the Pentium but not as advanced as the Pentium Pro. Dealing with a "fifth-generation-plus" design, Cyrix chose to leap ahead in nomenclature and call its chip the *6x86*, while AMD went with the more conservative *5K86*.

Cyrix's 6x86 is the first real chink in Intel's armor. The 6x86 achieves what no other Intel-compatible CPU has done before: It outperforms Intel's fastest mainstream chip, currently the Pentium/166. Its performance is based not on raw clock speed but on architectural efficiency within the chip. Running at just 133 MHz, the best 6x86 we tested outran a Pentium/166 on Winstone 96 by 5 percent.

Cyrix does not have its own semiconductor manufacturing plants (fabs). With a price tag of $1 billion or more for a leading-edge fab, smaller companies like Cyrix must depend on alliances with existing manufacturers. The 6x86 is now manufactured for Cyrix by IBM Microelectronics, and both companies market the chip. In a few months, SGS-Thomson should begin manufacturing the 6x86 for Cyrix as well and will also sell it under its own name.

The 6x86 puts Cyrix into an entirely different market segment than it has played in previously. Earlier Cyrix chips delivered a good compromise between price and performance but were not leading-edge designs. Cyrix is now trying to shed its "economy" association and become known as a performance leader. The company is even going so far as to enter the system business so it can ensure that top-notch systems are built with its chips and aggressively marketed to create an upgraded brand identity.

GETTING RID OF MHz

Since the 6x86 is so much faster at a given clock speed, it was essential for Cyrix to move PC buyers' focus away from megahertz. To do this, Cyrix, in collaboration with its partners IBM Microelectronics and SGS-Thomson and its competitor AMD, developed the P-Rating Specification, which defines an approach to measuring performance relative to the Pentium based on comparing Winstone 96 results in a constant system configuration. Winstone 96, developed by Ziff-Davis Benchmark Operation, is a benchmark test suite used extensively by *PC Magazine* and other Ziff-Davis publications as a cornerstone of PC testing.

MicroDesign Resources, a Ziff-Davis subsidiary that provides technical analysis to the semiconductor and PC industries, is providing independent benchmark tests in conformance with the P-Rating Specification. Results of these tests are available in reports posted at MicroDesign's Web site (*www.chipanalyst.com*).

The processor vendors will avoid using MHz at all, calling the 133-MHz 6x86 chip, for example, a 6x86-P166+. The "+" at the end is not a part of the P-Rating standard but is a Cyrix marketing device intended to indicate that the chip's Winstone 96 performance not only matches that of the 166-MHz Pentium but exceeds it. In addition to the 6x86-P133+, Cyrix offers chips rated at P120+ (running at 100 MHz), P133+ (110 MHz), and P150+ (120 MHz). The "+" is justified for the P150+ and P166+ parts, which have an edge of several percent over the Pentium in a range of system configurations.

THE 6x86'S LIMITATIONS

The 6x86 lags the Pentium in clock rate primarily because it is currently built using a less-advanced semiconductor process technology than Intel's. IBM builds the 6x86 chips using what is called a 0.65-micron process, while Intel's fastest Pentiums (currently the 133-, 150-, and 166-MHz Pentiums, as well as the 200-MHz Pentium Pro) use a 0.35-micron process. The smaller the process dimension, the faster the chips run and the cheaper they are to make. In the second half of this year, Cyrix expects to move to a more advanced process, increasing the number of 133-MHz chips it can make and boosting the top clock speed to 150 MHz. At 150 MHz, the 6x86 should deliver performance close to the 200-MHz Pentiums due to ship this fall—especially if Cyrix succeeds in pushing the system bus speed to 75 MHz.

The 6x86 has two notable limitations. First, it is power-hungry. In a worst-case scenario, the 6x86-P166+ dissipates more than 21 watts, far more than Intel's 166-MHz Pentium (14.5 watts) under the same conditions. This requires 6x86 system makers to pay more attention to cooling and eliminates the portable computer market from the 6x86's realm.

The second limitation is floating-point performance. The P Ratings of the chips

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BENCHMARK TESTS

Pentium Competitors

Under Windows 95, the 6x86 gave the Pentium a run for its money. But under a 32-bit operating system—like Windows NT Workstation or OS/2 Warp Connect—the Pentium Pro, which was optimized for 32-bit code, led the pack.

What the Numbers Mean

We tested four PCs powered by Cyrix 6x86 processors: two with the P150+ (120-MHz) version of the CPU and two with the P166+ (133-MHz) version. We ran popular 32-bit applications on these systems to find out how well their performance scaled under Microsoft Windows 95, Microsoft Windows NT Workstation 3.51, and OS/2 Warp Connect 3.0. We then compared their performance against similar Pentium and Pentium Pro PCs.

We chose applications by researching what users actually run on these operating systems. For Windows 95 testing, we used our industry-standard Winstone 96 and WinBench 96 benchmark tests. For Windows NT testing, we used 32-bit applications that run under both Windows 95 and Windows NT. To emulate power-user applications, we chose Adobe Photoshop 3.04; AutoCAD, Release 13 for PCs, C3 Version; Symantec's C++ Compiler 7.20; CorelDraw 6.0; and Micrografx's Picture Publisher 6.0. To emulate what an average user looking for top-flight performance might choose, we used Microsoft Excel for Windows 95 7.0 and Microsoft Word for Windows 95 7.0. We decided not to use Windows 3.*x* applications under OS/2, because we wanted to stay with 32-bit applications, and Windows 95 apps will not run under OS/2. For OS/2 testing, we chose SPG's ColorWorks for OS/2, Version 1.0, and IBM's Visual Age C++ for OS/2, Version 3.0.

We tested under different memory configurations to achieve results that would compare with those garnered by common end-user configurations; these results provide a reasonable means of comparing processor performance. For testing under Windows 95 and OS/2, we installed 16MB of RAM, which served as the common configuration. We also conducted OS/2 testing with 32MB of RAM to ensure that the tests would be less bound by disk I/O and that the systems' CPU performance would account for more of the results. For testing under Windows NT, we loaded each system with 32MB of RAM, which served as the common configuration; we also tested with 64MB to lessen the impact of disk performance. (In fact, 64MB of RAM or greater is probably more common than 32MB for professionals using applications like Photoshop and Picture Publisher.) With more memory installed, an operating system's need to swap to disk is greatly reduced and on some tests eliminated, providing results that reflect the processor subsystem's performance to a greater degree.

Our benchmark tests under Windows 95 and our applications tests under Windows NT with the systems running 64MB of RAM yield results that best isolate the processor subsystem. Even results gleaned under OS/2 by systems running 32MB of RAM reflect disk I/O, but to a lesser degree than the 16MB results do; the 32MB results better reflect overall system performance. Graphics subsystem performance also influenced test scores, although to a lesser degree than memory and disk subsystems did, because most of our tests are not graphics-intensive. Although you might suspect that tests under Adobe Photoshop, Picture Publisher, and ColorWorks would stress graphics processing, in fact they heavily stress CPU processing, spending much time conducting complex rendering or filtering calculations prior to painting the screen.

Windows 95 Tests The Sys Performance C166+ from Sys Technology led the Cyrix-based systems on both the $CPUmark_{16}$ and $CPUmark_{32}$ test suites, which are synthetic benchmark tests meant to isolate processor, cache, and memory subsystem performance with no disk and graphics I/O. When compared with a Pentium/166-based PC, however, the Cyrix P166+ machines had scores 1 to 9 percent lower on our CPUmark tests. The two 6x86 P150+ systems' scores were also up to 2 percent lower than the average Pentium/150 PC. These results are based on systems using Intel's 430FX PCIset (Triton) chip set, which does not support the 6x86's linear-burst mode. The 6x86 instead has to use a Pentium-compatible burst mode that introduces an extra bus cycle in about half of all burst transfers. This factor affects Cyrix systems' CPU performance under any operating system. When chip sets that support the 6x86's linear-burst mode become available, the 6x86

MICROSOFT WINDOWS 95

Bold type denotes first place.

— Average Pentium/150 (Feb. 20, 1996)
— Average Pentium/166 (Feb. 20, 1996)

	ZD Winstone 96 Score	ZD Graphics WinMark 96 Millions of pixels per second	ZD Disk WinMark 96 Score	ZD $CPUmark_{16}$ Score
Magitronic Power-CX150 (Cx 6x86-P150+)	68.0	21.9	1,080	272
SPI Mansfield 6x86 P150+ (IBM 6x86-P150+)	73.8	27.5	1,150	270
MicroFlex-686/P166+ (Cx 6x86-P166+)	77.4	29.0	1,190	287
Sys Performance C166+ (Cx 6x86-P166+)	79.6	**36.6**	1,200	299
Gateway P5-166 (Pentium/166)*	75.7	25.3	1,090	303
HP Vectra XU 6/150 (Pentium Pro/150)*	68.3	22.6	**1,280**	269
Gateway G6-200 (Pentium Pro/200)*	**75.6**	31.4	1,100	**352**
	BETTER▶	BETTER▶	BETTER▶	BETTER▶

* Reported for comparison.

should be able to catch up or even exceed the Pentium in CPU performance as measured on our benchmark tests.

Our Winstone 96 tests measure system performance with 16-bit applications. The fastest 6x86-P166+ system beat the comparison Pentium/166 by 5 percent and beat our average P/166 PC by a comfortable 15-percent margin. The two P150+-based systems also beat the Pentium/150 average by as much as 15 percent. With their slightly faster disk subsystems and strong graphics performance, the 6x86-P166+—based systems topped the charts on our Winstone tests. For now, it appears that the Cyrix 6x86 processor has stolen the performance lead from Intel when running on 32-bit operating systems that still contain 16-bit code, such as Windows 95.

Our Disk WinMark 96 and Graphics WinMark 96 tests measure disk and graphics subsystem I/O, respectively. The two 6x86-P166+ systems, both using Quantum Fireball 1280A hard disks (historically the fastest Enhanced IDE disks we have tested), were able to beat out the comparison Pentium/166 PC, as well as the average posted by the Pentium/166 machines tested in our roundup of February 20, 1996. The 6x86-based systems (except the Magitronic Power-CX150) each used a Matrox MGA Millennium graphics card. The 6x86-P166+ units showed surprising muscle on our Graphics WinMark test, posting scores about 29 percent higher than those garnered by the reference Pentium/166 PC.

For comparison, we tested two Pentium Pro machines running Windows 95: the Gateway G6-200 and the HP Vectra XU 6/150. As expected, the Pentium Pros did not fare well under Windows 95. Although the Pentium Pro's out-of-order, decoupled execution engine increases performance when executing 32-bit compiled code, it causes stalls in 16-bit applications (such as those in our Winstone 96 test suite) that frequently load segment registers. Certain operations in handwritten assembler code can also cause Pentium Pro pipeline stalls. Specifically, 16-bit code can stall whenever an 8-bit partial register update is followed by a read of the full 16-bit version of the register. Windows 95 still contains handwritten assembler code that may cause the partial register stalls on a Pentium Pro unit.

Windows NT Workstation 3.51 Tests Perhaps the most telling test results are the scores posted on the 64MB applications tests under Windows NT. When run on systems with 32MB of RAM, some of our Windows NT tests are still influenced by disk performance. While disk, CPU, memory, and graphics showings give an overall view of system performance, concentrating on the 64MB memory configurations can reveal CPU and memory subsystem performance characteristics and minimize disk impact. For the purpose of analysis, we concentrate on 64MB test results to determine processor/memory subsystem performance.

Our most stressful graphics tests were those involving Word and Excel, because these programs stress integer and graphics operations by quickly updating the screen in rapid succession. These tests, however, do not appear to stress memory subsystems beyond 32MB of RAM, as evinced by the nearly identical results obtained at both memory configurations. The top-scoring 6x86 machine, the Sys PC, was edged out by the Pentium/166 reference system in Word and by the two Pentium Pro comparison systems (by a comfortable margin) in both Word and Excel.

The AutoCAD test run with 64MB of RAM displays intermittent, heavy disk I/O and is graphics-intensive. This test uses both integer and floating-point calculations. The results showed that the Pentium/166 comparison system was slightly slower than the fastest 6x86 machine, the Sys PC, although both Pentium Pro PCs were up to 71 percent faster.

Our C Compiler test does not stress graphics performance; instead, it exercises the CPU subsystem and includes heavy disk I/O, even with 64MB of RAM. Helped by its strong disk performance, the Sys PC was 11 percent faster than the Pentium/166 comparison unit, although it was beaten by both Pentium Pro workstations.

The Gaussian Blur test under Photoshop uses integer calculations and utilizes minimal disk I/O with 64MB. The top-performing 6x86-based system was the Sys PC, but the Pentium/166 comparison machine was able to beat it by a small margin. Both Pentium Pro systems easily outperformed the Sys PC with 64MB—the HP Vectra XU by nearly 90 percent and the Gateway G6-200 by 140 percent.

The Lighting Effects test under Photoshop stresses floating-point operations and heavy disk I/O, even on systems with 64MB of RAM. Again, the fastest 6x86-based machine was the Sys PC, but again it was beaten by all the comparison systems. In fact, the Pentium/166 beat the Sys PC by more than 25 percent on this test, possibly a result of enhanced floating-point processing ability compared with the Cyrix chip. It was here that the Pentium Pro processor exhibited its floating-point performance muscle. The HP Vectra XU 6/150 beat the Sys PC by 41 percent, while the Gateway G6-200 outran the Sys machine by an impressive 55 percent.

Our three Picture Publisher tests exercise different CPU calcula-

continues

MICROSOFT WINDOWS NT WORKSTATION 3.51

Lower scores represent better performance Bold type denotes first place	Microsoft Excel Script 32MB Min:sec	Microsoft Excel Script 64MB Min:sec	Microsoft Word Script 32MB Min:sec	Microsoft Word Script 64MB Min:sec	AutoCAD 32MB Min:sec	AutoCAD 64MB Min:sec	C Compiler 32MB Min:sec	C Compiler 64MB Min:sec
Magitronic Power-CX150 (Cx 6x86-P150+)	0:57	0:57	0:41	0:41	5:26	5:43	3:35	3:22
SPI Mansfield 6x86 P150+ (IBM 6x86-P150+)	0:40	0:39	0:32	0:32	5:43	5:28	3:01	2:59
MicroFlex-686/P166+ (Cx 6x86-P166+)	0:46	0:42	0:36	0:33	5:39	5:19	3:02	2:59
Sys Performance C166+ (Cx 6x86-P166+)	0:39	0:38	0:31	0:30	5:22	5:11	2:51	2:50
Gateway P5-166 (Pentium/166)*	0:41	0:40	0:28	0:30	5:29	5:14	3:11	3:09
HP Vectra XU 6/150 (Pentium Pro/150)*	0:32	0:31	**0:22**	**0:22**	3:58	3:48	2:22	2:22
Gateway G6-200 (Pentium Pro/200)*	**0:30**	**0:27**	0:23	0:23	**3:26**	**3:01**	**2:06**	**1:58**
Average Pentium Pro/150 (Feb. 20, 1996)	0:39	0:37	0:28	0:27	4:13	4:05	2:26	2:20

BENCHMARK TESTS

continued

tions, with no stress put on the graphics subsystems and no disk I/O with 64MB of RAM. The Gaussian Blur and Hue Saturation tests stress integer performance. The File Rotate test is mostly FPU-intensive, with some integer calculations as well.

On the Gaussian Blur test, the Pentium/166 reference system edged out the top 6x86, the Sys PC. Similarly, the two Pentium Pro–based machines, with their more powerful processing ability on 32-bit code, beat the Sys machine by a wide margin. The integer-based Hue Saturation test shows the 6x86 chip's performance lead when the chip deals with the more common math calculations that processors perform. With 64MB RAM, the Sys PC beat the Pentium/166 comparison system by 8 percent and scored only 15 percent lower than the Pentium Pro/150–based PC.

Using CorelDraw 6.0, we were able to test the systems' floating-point performance, effectively eliminating all influence from disk activity. Except on the Grouping Vector Object test, which may contain some integer calculations, the Gateway P5-166 with 64MB of RAM edged out the top-performing 6x86-based PC, the Sys PC, in all cases. None of the CorelDraw tests showed physical disk usage, so we can draw some strong conclusions about CPU/memory subsystems from these tests.

MICROSOFT WINDOWS NT WORKSTATION 3.51

MICROSOFT WINDOWS NT WORKSTATION 3.51

are based on Winstone 96, which—like the vast majority of today's PC applications—uses little floating-point math. For computer-aided design and some 3-D applications, however, the 6x86 will fall short of Pentium performance, because its on-chip math coprocessor is not as fast as the one in the Pentium—a weakness shared by all the Pentium alternatives.

AMD LATE TO PENTIUM CLASS

In the 486 era, AMD was the clear number-two player, behind Intel, and sold far more 486 chips than Cyrix. AMD's 486 was not an original design, however, but was derived from Intel's design. Starting with the Pentium generation, AMD decided—for both legal and technical reasons—to develop its own design. But lack of *x*86 design experience turned out to be a stumbling block: AMD found that the much-heralded 5K86 (originally called the K5) took longer to bring to market than the company had hoped—and it needs still more refinement to reach its performance goals.

AMD's first Pentium-pin-compatible chips, the 5K86-P75 and 5K86-P90, should be shipping by the time you read this. These chips are at the low end of the Pentium performance spectrum, so pricing is aggressive ($75 and $99 for Pentium/75 and /90 equivalents, respectively).

Like Cyrix's 6x86, the 5K86 uses a more advanced internal design that was supposed to deliver higher performance than the Pentium at a given clock rate. Unfortunately, the initial version of the AMD design failed to deliver on this promise.

AMD ran into trouble, because it

On tests emphasizing floating-point-unit performance, the Pentium Pro comparison systems evinced their FPU prowess. The HP Vectra XU bested the Sys PC by 25 to 50 percent, and the Gateway G6-200 beat it by 25 to nearly 100 percent on all but the Grouping Vector Object test. There are few applications that use floating-point calculations, but these results show that Intel has a commanding lead in floating-point performance, at least in the *x*86 world. The Pentium/166 comparison system again showed the possibility of an enhanced FPU by edging out the Sys machine on the Blending and Rotating tests, as well as by eclipsing the Sys machine by 53 percent on the Extruding Artistic Text test.

OS/2 Warp Connect 3.0 Tests Testing under OS/2 Warp Connect 3.0 confirmed what IBM has long claimed: OS/2 is a true 32-bit operating system with little 16-bit code. Tests run on the two Pentium Pro systems particularly helped to lead to this conclusion. As expected, the Gateway G6-200 and the HP Vectra XU 6/150 were better performers under Windows NT than under Windows 95. It is well documented that the Pentium Pro chip cannot handle the segment loads and partial dependencies that can happen with the 16-bit code still found in Windows 95. But our OS/2 test results showed that CPU performance scales to this operating system as it does to Windows NT. In other

continues

incorrectly estimated the mix of instructions in typical PC applications. The 5K86 design took shortcuts in the way it implemented a few instructions that AMD assumed were infrequently used. In reality, these instructions are used much more than AMD expected, and their slow execution drags down overall performance. The net result is that the first 5K86 chips merely match Pentium performance at a given clock rate, despite their more complex internal design and faster performance on some code sequences.

AMD has also had trouble getting the 5K86 design to run at high clock rates. The first 5K86 chips have a maximum speed of 90 MHz, even though they use a more advanced semiconductor process (manufacturing) technology than Cyrix's 6x86, which runs at up to 133 MHz. AMD uses a more complex design that is intended to do more work in each clock cycle, while Cyrix has a simpler design that enables a higher clock rate. Unfortunately for AMD, so far this tradeoff has been a poor one: AMD is saddled with a design that is limited in clock rate yet does less work in each clock cycle than Cyrix's chip.

ENHANCING THE 5K86

AMD says these problems won't be hard to fix. Its designers are now revising the 5K86 design, adding logic to speed the slow instructions and making a few other refinements to eliminate bottlenecks the designers found after they had a chance to exercise the chip thoroughly. At the same time, the circuitry is being tuned to enable the chip to run at higher clock rates. The

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Std./Max. Memory	8MB/32MB	8MB/72MB	8MB/72MB	8MB/72MB
Hard Drive	720MB	510MB (removable)	810MB (removable)	1.35GB (removable)
Cache	16KB Internal	256KB, 64-Bit	256KB, 64-Bit	256KB, 64-Bit
Diskette Drive	Internal 3.5" 1.44MB	Modular 3.5" 1.44MB	Modular 3.5" 1.44MB	Modular 3.5" 1.44MB
Display	10.4" Color Dual Scan	10.4" (640x480) CSTN	10.4" (800x600) CTFT	10.4" (800x600) CTFT
Video Graphics	32-Bit Local Bus	32-Bit PCI Local Bus 1MB DRAM	32-Bit PCI Local Bus 1MB DRAM	32-Bit PCI Local Bus 1MB DRAM
PCMCIA Slots	2 Type II	2 Type II	2 Type II	2 Type II
16-Bit Audio	No	Yes	Yes	Yes
Internal CD-ROM Drive	N/A	Optional QuadSpeed	Optional QuadSpeed	Optional QuadSpeed
Pointing Device	Optical Trackball	EasyPoint™ II	EasyPoint II	EasyPoint II
NiMH Battery	3-5 Hours	2-4 Hours	2-4 Hours	2-4 Hours
Ports	Keyboard/Pointing Device, Enhanced Parallel, Serial, External SVGA	External Keyboard/ Pointing Device, Headphone/Speakers, Microphone, Infrared Communication, External SVGA	External Keyboard/ Pointing Device, Headphone/Speakers, Microphone, Infrared Communication, External SVGA	External Keyboard/ Pointing Device, Headphone/Speakers, Microphone, Infrared Communication, External SVGA
Software	Windows® 95 or Windows 3.1	Windows 95 or Windows 3.1; MS-Video for Windows, Compaq Sound System	Windows 95 or Windows 3.1; MS-Video for Windows, Compaq Sound System	Windows 95 or Windows 3.1; MS-Video for Windows, Compaq Sound System
Dimensions/Weight	11.9"x9"x2.2"/6.5lbs.	12.2"x9"x2"/7.1lbs.	12.2"x9"x2"/7.4lbs.	12.2"x9"x2"/7.4lbs.
Worldwide Warranty**	3-Year Limited	3-Year Limited	3-Year Limited	3-Year Limited
Price†	**$2,399**	**$2,899**	**$4,099**	**$4,799**

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BENCHMARK TESTS

continued
words, the better performance that the Pentium Pro exhibits under Windows NT is the same that it displays under OS/2.

It was difficult to separate out disk performance. Again, for comparison purposes, we concentrated on the 32MB test results, because they better reflect CPU/memory performance. Bear in mind, however, that the 32MB results still reflect substantial disk I/O.

We tested ColorWorks for OS/2 with six different filters. The All Filters, Graphics State Files, and Pixel Displacement filters had little or no disk I/O with 32MB of RAM and therefore gave the best measurement of CPU/memory subsystem performance. The All Filters test stresses integer performance, but because it is run on a 32-bit operating system, the Pentium Pro systems were the top performers. The MicroFlex-686/P166+ was the fastest 6x86-based system; it also edged out the Pentium/166 comparison system. The Graphics State Files test stresses both integer and floating-point math. Again, the two Pentium Pro systems outran all of the other machines. The Sys machine, however, was able to outperform the Pentium/166 system by 6 percent on this test. Our Pixel Displacement test is FPU-intensive, which clearly gives the advantage to the Pentium Pro workstations as well as to the Gateway P5-166 comparison system with 32MB of RAM. The results here closely tracked the Picture Publisher results under Windows NT. The other filters—Tune Image Color, Coon's Warp, and File Rotate—generate heavy disk I/O, and tests with these filters provide a good measure of system performance.

The Visual Age test also generates heavy disk I/O. Because the disk is the slowest subsystem in a PC, it is no surprise that the HP Vectra XU 6/150 ran this test the quickest: Its HP Seagate Barracuda ST 32550N Fast SCSI-2 hard disk propelled the machine to the fastest completion time.—*Analysis written by Richard Fisco*

How We Tested

We tested all systems with 1GB hard disks or larger and 256K L2 cache. We tested each system under three operating systems: Microsoft Windows 95, Microsoft Windows NT Workstation 3.51, and OS/2 Warp Connect 3.0 (we formatted hard disks using FAT, NTFS, and HPFS, respectively). We tested under Windows 95 with 16MB of RAM and each vendor's preinstalled graphics driver for 1,024-by-768 resolution with 256 colors, small fonts. We tested under Windows NT with 32MB and 64MB of RAM using each vendor's preinstalled graphics driver for 800-by-600 resolution with 16.7 million colors, small fonts. We tested under OS/2 with 16MB and 32MB of RAM using each vendor's preinstalled graphics driver for 640-by-480 resolution with 16.7 million colors, small fonts.

Microsoft Windows 95 We used our benchmark test suite **ZD Winstone 96, Version 1.0,** to measure each unit's performance when running typical Windows applications. Winstone 96 measures the time a PC takes to execute a set of scripts that exercise 13 Windows applications.

We used WinBench 96, Version 1.0, to measure graphics, disk, and CPU performance. The **ZD Graphics WinMark 96** score, based on 115 tests of Windows GDI functions, represents the performance of each PC's graphics subsystem. The **ZD Disk WinMark 96** score represents disk-subsystem performance. The **ZD CPUmark$_{16}$** and **ZD CPUmark$_{32}$** scores indicate the speed of the CPU subsystem under 16- and 32-bit Windows operating systems, respectively.

Microsoft Windows NT Workstation 3.51 We used test scripts for seven applications: Microsoft Excel for Windows 95 7.0; Microsoft Word for Windows 95 7.0; Adobe Photoshop 3.04; Auto-

OS/2 WARP CONNECT 3.0

	ColorWorks								
	All Filters		Graphics State Files		Pixel Displacement		Tune Image Color		Coon's Warp
Lower scores represent better performance.	16MB	32MB	16MB	32MB	16MB	32MB	16MB	32MB	32MB†
Bold type denotes first place.	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec	Min:sec
Magitronic Power-CX150 (Cx 6x86-P150+)	4:46	4:01	2:17	1:43	1:06	0:27	1:27	1:04	2:38
SPI Mansfield 6x86 P150+ (IBM 6x86-P150+)	4:43	3:52	2:35	1:40	1:18	0:27	1:23	1:03	2:26
MicroFlex-686/P166+ (Cx 6x86-P166+)	4:48	3:35	2:29	1:32	1:18	0:24	1:16	0:57	1:26
Sys Performance C166+ (Cx 6x86-P166+)	4:35	4:01	2:29	1:30	1:17	0:24	1:16	0:57	2:29
Gateway P5-166 (Pentium/166)*	5:27	3:30	2:55	1:36	1:36	0:21	1:12	0:47	2:37
HP Vectra XU 6/150 (Pentium Pro/150)*	3:09	2:18	2:12	1:18	1:09	0:17	1:10	0:50	1:57
Gateway G6-200 (Pentium Pro/200)*	3:02	1:45	2:18	1:00	1:32	0:13	1:01	0:38	2:51

* Reported for comparison
† We did not conduct the Coon's Warp test at 16MB

result of these efforts—if all goes well—will be a new crop of 5K86 chips in the fall that delivers much higher performance.

In the third quarter, AMD expects to ship a new 100-MHz 5K86, which it believes will earn a P133 rating. No measured benchmark test results have been disclosed, but AMD is standing by its claim that the second-generation 5K86 design will deliver the performance of a Pentium that runs at a clock rate up to 30 percent higher. If it achieves this, AMD's enhanced 5K86 will be competitive with Cyrix's 6x86 at a given clock rate. But AMD is far behind in clock rate, so even if it reaches the per-clock performance goal, it will be hard for AMD to catch Cyrix's performance. By year's end, AMD expects to have a 120-MHz 5K86 with a P150 rating; by then, Cyrix will probably have a 150-MHz 6x86-P200+.

NEXGEN FADES AWAY

Although NexGen was the first company to ship a "586" Pentium competitor, the company was never able to capture much of the market. NexGen's 586 was handicapped by its unique bus design, requiring special chip sets and motherboards, and by its lagging performance.

In a deal consummated early this year, AMD bought NexGen. Because of the delays with the 5K86 design, AMD wanted to have another source of designs to ensure that it would have profitable chips to build in its big new fab. NexGen's 586 was not the attraction, however; it was the design that would have been the NexGen 686 and now will be the new AMD K6.

CAD, Release 13 for PCs, C3 Version; Symantec's C++ Compiler 7.20; CorelDraw 6.0; and Micrografx's Picture Publisher 6.0.

Our **Microsoft Excel Script** and **Microsoft Word Script** tests are macro-driven and perform a number of common operations using typical data files. Functions such as spell-checking, font changes, copies and deletes, repaginations, and print previews are performed in the Word script, and operations such as recalculations, statistical functions, cuts and pastes, and charting are performed in the Excel script.

Testing under **AutoCAD** exercises a broad range of system functions, including a CPU's integer and floating-point capabilities and disk and video subsystem capabilities. There are three key areas of our AutoCAD test script: opening drawing files (including 2-D and 3-D drawings), performing 2-D manipulations (including entity additions, entity deletions, undo commands, regens, zooms, and pans), and performing 3-D manipulations (including 3-D–view rotations and alterations, utilization of the Hide command, 3-D move operations, and a variety of rendering variations).

Testing under **C Compiler** involves the use of the World Wide Web Consortium (W3C) Reference Library benchmark test, which consists of a set of C-source-code modules, largely platform-independent, which may be used to build World Wide Web servers, clients, and proxies. The W3C library is provided by CERN and has 119 files containing 1.1 million bytes of software source code. The programs were compiled into a 32-bit DLL library with Version 7.20 of Symantec's C++ development environment running under Windows NT.

Testing in Adobe Photoshop involved the use of two filters. The Gaussian Blur filter blurs a selection by an adjustable amount. This filter adds low-frequency detail and can produce a hazy effect. For our **Gaussian Blur** test, we applied a blur of radius 25. The Lighting Effects filter allows application of up to 16 different light sources on an image; we tested with default spotlight settings. The **Lighting Effects** test stresses floating-point processing capability and is applied to an 18.5MB TIFF image.

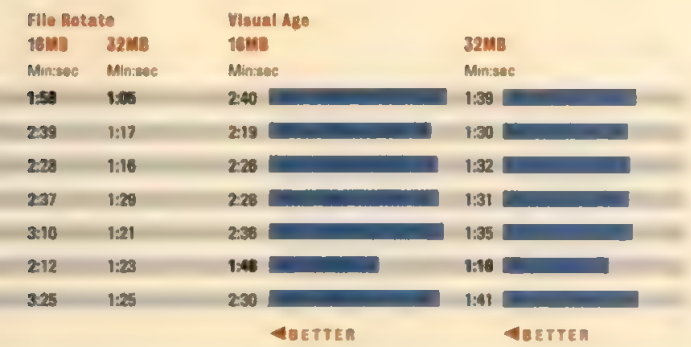
Testing with Micrografx's Picture Publisher involved the use of three filters, each applied to a 16MB test image. In the **Gaussian Blur** test, the Gaussian Blur filter blurs the entire test image, which has a radius of 25. The **Hue Saturation** test involves three tasks: maximizing saturation levels, shifting the hue values 180 degrees, and inverting the colors on the entire image. The **File Rotate** test applies a 347-degree clockwise rotation to the entire test image.

Testing under CorelDraw involved the use of four filters. These filters stress floating-point processing capability. The **Blending Two Objects** test blends two dissimilar textured objects and has 999 steps to the blend, a 360-degree rotation, and a loop. The **Rotating Vector Object** test applies a 15-degree rotation to an object. The **Grouping Vector Object** test arranges the objects within a vector group. The **Extruding Artistic Text** test changes the font size and moves, stretches, and extrudes the font. We tested to a level of 25.

OS/2 Warp Connect 3.0 We used test scripts for two separate applications: ColorWorks for OS/2, Version 1.0, and Visual Age C++ for OS/2, Version 3.0.

Testing under ColorWorks involved the use of six filters. We ran all tests on a 9MB TIFF file. The **All Filters** test applies all available filters (smoothing, sharpen, noise-reduction, and edge-detection filters, along with special filters and custom filters) simultaneously, utilizing integer calculations. The **Graphics State Files** test (which uses both integer and floating-point calculations) loads a GRS file into the test image. The file applies a filter and performs color mapping. The **Pixel Displacement** test (which uses floating-point calculations) displaces pixels and maps the image file. The **Tune Image Color** test changes the color attributes of all pixels, as well as inverting the color on all pixels (these are integer calculations). Color saturation is maximized, and hue values are shifted 180 degrees (these are floating-point calculations). The **Coon's Warp** test (which utilizes integer calculations) turns the entire image into a masked selection and floats it while applying a particular distortion map to it. We performed this test with 32MB of RAM only, because it will not run properly with 16MB. The **File Rotate** test (which uses integer calculations) takes the entire image, floats it, and rotates it 347 degrees.

Testing under **Visual Age C++** for OS/2 involves the use of the Visual Age compiler to create the target executable VBMAIN.EXE. During compilation, the project is rebuilt, files are recompiled, and resource files are added and linked to produce the executable.



In fact, AMD has recently pulled the plug on the NexGen 586, and the NexGen name will disappear as the company is integrated into AMD. With the 5K86 shipping, supporting the 586 wasn't worthwhile to AMD. The market for the chip was small, and profits were modest.

INTEL'S P55C AND MMX RAISE THE BAR

The game will change in the late fall with the debut of Intel's next-generation Pentium processor, code-named P55C. This chip will mark the debut of Intel's integrated multimedia instruction-set extensions, called MMX. These additions to the venerable *x*86 instruction set, which has remained nearly unchanged since the 386, will significantly boost performance on many audio, graphics, and image-processing applications. The processor will also have larger on-chip caches and other enhancements to boost its performance on all applications—and it will consume less power, making it well suited for portables.

MMX will deliver the most noticeable performance boost in PCs that don't use accelerator chips for multimedia functions but instead depend on the host processor to perform tasks such as video decompression in software. With MMX and a fast processor such as a 200-MHz P55C, for example, it should be possible to decode MPEG-2 video without a hardware decoder chip; without MMX, this is not likely to be possible without compromising quality.

Cyrix's next part is code-named M2. This chip will be based on the 6x86 CPU core but with various enhancements to enable its clock speed to be increased. Cyrix

First Cyrix 6x86 PCs: How Good? How Fast?

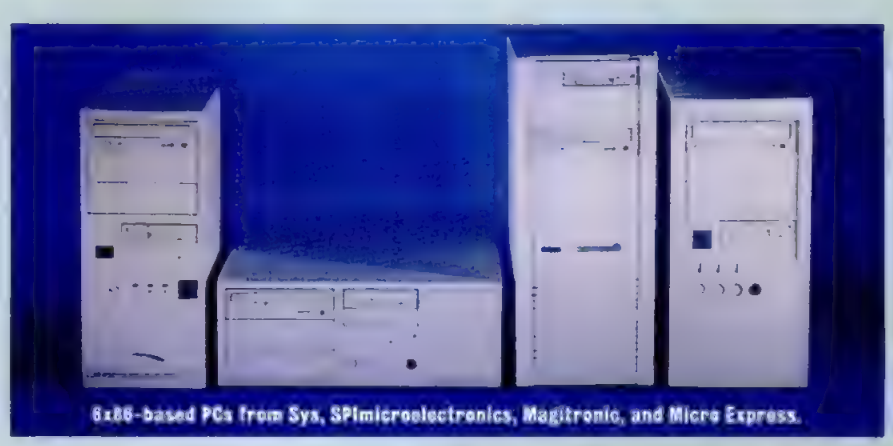
By Cade Metz

Like the archetypal tortoise that beat the hare, Cyrix Corp.'s 6x86 processors outperform their Intel counterparts with cunning rather than quickness. The 120-MHz P150+ and the 133-MHz P166+ run at slower clock speeds than their Pentium competitors, but significant architectural enhancements have produced Winstone 96 scores that rival and even surpass those of the Pentium/150 and the Pentium/166. Although such performance has prompted Cyrix to create its own line of PCs—which should be available by the time you read this—the 6x86 was introduced by an eclectic group of vendors including Magitronic Technology, Micro Express, SPImicroelectronics, and Sys Technology. For this story, we acquired a system from each of these vendors to test their performance relative to that of Pentium PCs under different operating systems.

When the 100-MHz 6x86 processor was announced in October of 1995, Cyrix's in-house tests on the chip produced results that matched those of the Pentium/120, but its 394-mm^2 die size was deemed too bulky for the marketplace. Once Cyrix moved from a three-layer semiconductor manufacturing process to a five-layer-metal process, the chip was shrunk to 204 mm^2 and became an attractive alternative to the Pentium.

The 6x86 incorporates many architectural enhancements made to the Pentium Pro—including out-of-order execution and speculative execution—without abandoning full *x*86 instruction-set compatibility. Consequently, it may outperform Pentium chips running at higher clock speeds, and it is more attuned to a mixed 16- and 32-bit environment than the Pentium Pro.

Cyrix followed the 100-MHz 6x86 with 110-, 120-, and 133-MHz versions of the chip. Along with AMD, IBM, and SGS-Thomson, Cyrix created a new naming convention, called the P-Rating Specification, using Intel's clock speeds to garner the respect of PC manufacturers and buyers. Thus, these chips were dubbed the P133+, P150+, and P166+, while the 100-MHz chip was renamed the P120+.



6x86-based PCs from Sys, SPImicroelectronics, Magitronic, and Micro Express.

SYS PERFORMANCE C166+

Sys Technology's 6x86 machine, the Sys Performance C166+ ($2,699 with Windows 95), goes a long way toward justifying the new P-Rating system. Its Winstone and Graphics WinMark scores were the highest in PC Labs' history—eclipsing the scores of our comparison system, the 166-MHz Gateway P5-166 XL, and the average scores of the 23 Pentium/ 166 machines tested for our issue of February 20, 1996. On our Disk WinMark 96 tests, the Sys Performance C166+ delivered an impressive score of 1,200, which again topped the scores of both the Gateway comparison system and the average Pentium/166 machine. The machine's CPUmark$_{16}$ and CPUmark$_{32}$ scores were much higher than the average scores in our Pentium/133 roundup of December 5, 1995, but less than the average Pentium/166 results.

Although the Sys PC's scores on our Windows NT- and OS/2-based tests were not as conclusive as those of their Windows 95 counterparts, they still rivaled the scores of the 166-MHz Gateway PC. It handled our Microsoft Excel, AutoCAD, and C++ Compiler scripts significantly faster than the Pentium system but was slightly slower on our tests conducted under Microsoft Word and Adobe Photoshop. Under OS/2, the Sys PC produced mixed results with 32MB of RAM, but it consistently outperformed the Pentium/166 system when configured with 16MB of RAM, thanks to its fast Quantum Fireball hard disk.

The Sys machine we saw was configured with 256K of L2 cache (upgradable to 512K for $50), a 1.2GB hard disk, and a Matrox MGA Millennium graphics card with 2MB of WRAM. The Toshiba 6.7X CD-ROM drive and 15-inch MAG monitor are welcome accoutrements.

MICROFLEX-686/P166+

The first company to bring the 100-MHz 6x86 to market was also the first to introduce a P166+ machine. Although the $2,399 MicroFlex-686/P166+, from Micro Express, did not perform as well as the Sys PC, it still fared better than most Pentium/166 desktops. Like the Sys entry, the MicroFlex unit had 256K of pipelined-burst L2 cache, a 1.2GB hard disk, a Matrox MGA Millennium graphics card with 2MB WRAM, and a 15-inch monitor.

The MicroFlex PC's Winstone, Graphics WinMark, and Disk WinMark scores—which were only slightly below those of the Sys PC—also topped the marks of both the Gateway comparison machine and most Pentium/166 systems. Again, the CPUmark$_{16}$ and CPUmark$_{32}$ scores fell below the average Pentium/166 scores but eclipsed the average Pentium/133 marks.

Pentium Competitors

Under Windows NT, the MicroFlex system was consistently slower than the Sys PC, but it was in the same ballpark on every measure except our tests under Excel and AutoCAD. The Sys PC and the Gateway comparison PC were slightly slower than the MicroFlex PC under OS/2 with 32MB of RAM, while the two Cyrix machines equally outperformed the Intel machine with 16MB.

In addition to its P166+ machine, Micro Express offers P120+ and P150+ systems. Although the MicroFlex-686/P166+ doesn't quite offer the performance of the Sys PC, it sells for roughly $300 less and still rivals its faster Intel competitors.

SPI MANSFIELD 6x86-P150+

Although the 6x86 was developed at Cyrix, it is manufactured by IBM Microelectronics, which is selling its own version of the chip under the IBM moniker. The 120-MHz IBM 6x86 is the cornerstone of SPImicroelectronics' SPI Mansfield 6x86-P150+, a $3,929 Windows 95 desktop PC ($3,879 with OS/2) with a 1.2GB hard disk, 256K of L2 cache, a Matrox MGA Millennium graphics card with 2MB of WRAM, a 4X Mitsumi CD-ROM drive, and a 15-inch monitor. This machine not only outperformed the average unit in our Pentium/150 roundup, it also compared well with the average Pentium/166.

Under Windows 95, the Mansfield PC's Winstone, Graphics WinMark, and Disk WinMark scores bested the average Pentium/150 scores as well as the average marks posted in our Pentium/166 roundup. Its scores on our $CPUmark_{16}$ and $CPUmark_{32}$ tests eclipsed those of its average Pentium/120 competitor while barely surpassing the average machine in our Pentium/133 roundup.

As a Windows NT PC, the Mansfield system performed on a par with the MicroFlex-686/P166+ and just beneath the Sys entry. Under OS/2, the Mansfield system tested well on our ColorWorks integer tests at 32MB and extremely well on both of our Visual

MAGITRONIC POWER-CX150

Although it used the same chip as the Mansfield PC, albeit with a Cyrix stamp instead of an IBM tag, the Magitronic Power-CX150 produced lower scores. Its performance was still competitive when compared with the average Pentium/150 machine. This $3,200 system offers 256K of L2 cache, a 1.6GB hard disk, an S3 Trio64V+ graphics card with 1MB of DRAM, a 15-inch monitor, and a 4X Toshiba CD-ROM drive.

The Magitronic unit barely edged out the Pentium/150 average on our Winstone, Graphics WinMark, and Disk WinMark tests. We suspect the unit is less optimized than the Mansfield PC. Also, its hard disk is not as fast as those used by other systems, and its graphics card has only 1MB of DRAM. Still, its $CPUmark_{16}$ and $CPUmark_{32}$ scores were better than the Mansfield PC's marks, as well as those of the average Pentium/133 system. With the exceptions of its poor timings on our tests under Word and Excel, the Magitronic produced Windows NT scores that were just below those of its SPI counterpart. Under OS/2, it performed much better than the Mansfield unit with 16MB of RAM, but it faltered with 32MB.

The Magitronic unit combines this performance with an impressive software suite, which includes the 1996 Grolier Multimedia Encyclopedia, Lotus SmartSuite 96, and Novell's PerfectWorks. Ironically, the Magitronic and its P150+ sibling, the SPI Mansfield 6x86-P150+, have steeper price tags than the two P166+ systems and are priced higher than most Pentium/150 machines (which averaged $2,800 at the time of our roundup of February 25, 1996).

CYRIX'S FUTURE

Belying clock speeds has not only allowed Cyrix to compete with the Pentium but has also led it to supplement these 6x86-based machines with its own line of PCs. As these machines begin to roll out, the 6x86 will continue to evolve. And IBM will have some company as SGS-Thomson also begins

also promises to have multimedia instruction-set extensions in the M2, but it remains to be seen whether they will be Cyrix's own version or Intel-compatible.

AMD's next-generation part is codenamed K6 and is likely to be marketed as the AMD 6K86. AMD plans to have multimedia extensions in the K6, and a recent cross-licensing agreement between Intel and AMD suggests that AMD will make the K6 Intel MMX-compatible.

THE ALTERNATIVES IN PERSPECTIVE

Cyrix (with its partners IBM Microelectronics and SGS-Thomson) has a strong offering to compete with high-end Pentium processors. AMD will be limited to the low end for at least the next six months, and it is too early to pass judgment on the company's position after that.

No matter how strong competitive products may be, the business reality is that Pentium competitors can take only a modest amount of market share. Intel has the manufacturing capacity and technology to stay on top. But in a market this large, a number-two and even a number-three position can be very profitable.

With the combined manufacturing capacity and marketing efforts of IBM Microelectronics and SGS-Thomson, as well as Cyrix's own marketing and sales efforts, Cyrix hopes to capture 10 percent of the Pentium market—which would be about 6 million chips this year—with the 6x86. This is an aggressive goal but not beyond the realm of possibility.

AMD has grander ambitions but is farther from realizing them. The company has set a goal of more than 30 percent market share, but this will be a long time coming. This year, AMD expects to ship about 3 million 5K86 processors—about 5 percent of the market. AMD is pushing hard to improve its position dramatically in 1997, but Cyrix and its partners, thanks to their superior product execution, now have a shot at unseating AMD as the number-two supplier of microprocessors.

For PC buyers, Pentium alternatives are likely to offer good value as PC makers pass on some of the savings in chip cost. In some cases, such as Cyrix's 6x86-P166+, the alternatives will offer leading-edge performance, but this benefit won't

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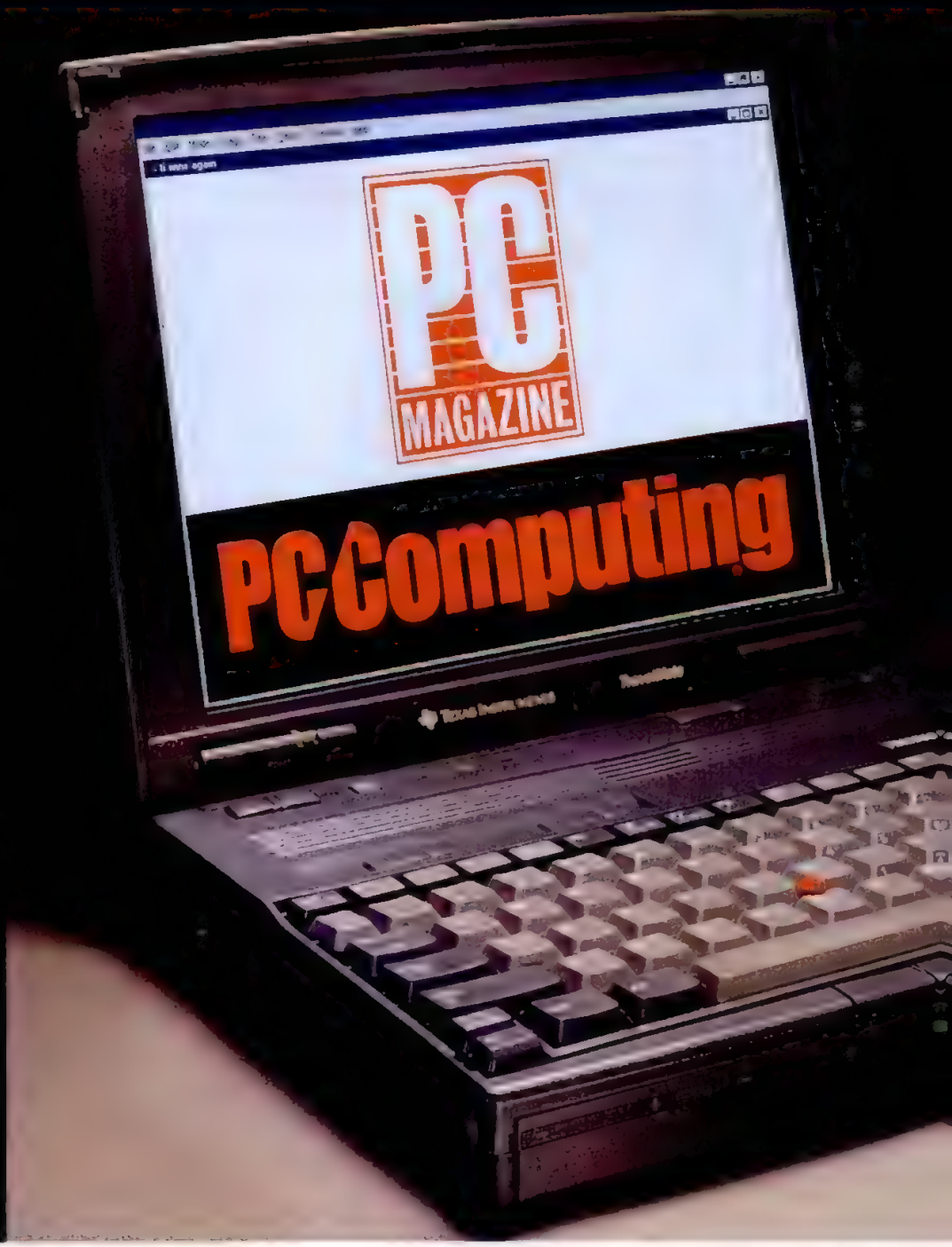

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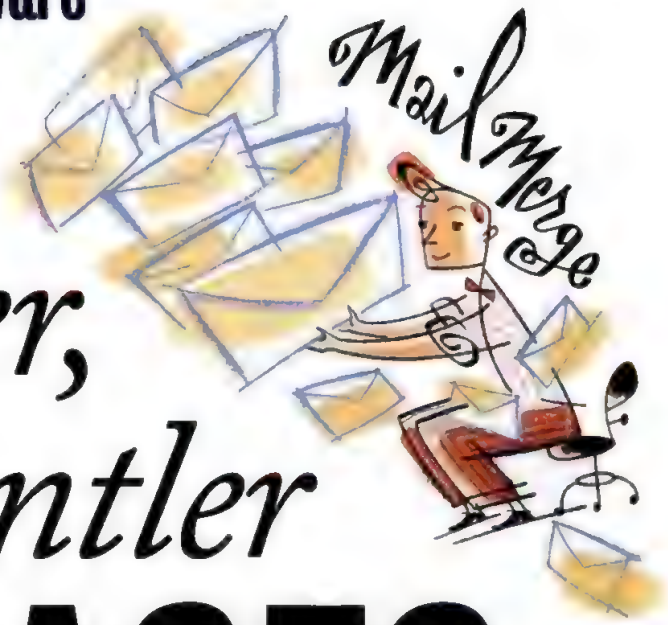

Kinder, Gentler DATABASES

Good news: These end-user databases harness estimable power under a host of wizards, genies, templates, and pre-built forms that make databases accessible tools for everyone.

By Joe Salemi

End-user databases, once thought of as simple mailing-list managers, have turned into powerful but friendly tools for managing the complex data needs of both individual users and entire organizations.

Windows 95 has significantly affected the market. In some products, such as Microsoft Access, 32-bit support has increased performance. Access also takes advantage of Windows 95's improved 32-bit OLE and built-in replication capabilities (using the Briefcase feature). All the products reviewed here, except for OS/2-based DBExpert, are Windows products, and some are specific to Windows 95. And all the products are new or have upgraded since our last roundup ("Balance of Power," June 28, 1994).

What exactly do we define as an end-user database? Years ago they were called nonprogrammable databases, which doesn't quite fit any more since most (though not all) of these products provide some programming capabilities. The best way to de-

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ILLUSTRATIONS BY STEVEN SALERNO

scribe these products is affordable (under $500) and able to help users of any experience level create sophisticated data-handling applications without programming. End-user databases provide a wide variety of built-in features such as wizards, templates, and sometimes complete application generators that help even novice users create databases to suit a variety of needs.

On the other hand, developer-oriented databases require programming experience, which often means *building* many of the database elements that end-user databases create automatically. The sidebar "When Wizards Aren't Enough" discusses some developer-oriented databases. You'll also find information about third-party add-ons for the end-user databases in the sidebar "End-User Database Add-Ons."

Vendors have realized that users need a simpler way to connect to organization-wide databases.

Since our last database evaluation, ease-of-use and automation features have advanced the most. Chief among them are database helpers, or wizards, that guide you through the process of creating database files, forms, reports, and—in some cases—the final application.

MAKING IT SIMPLE

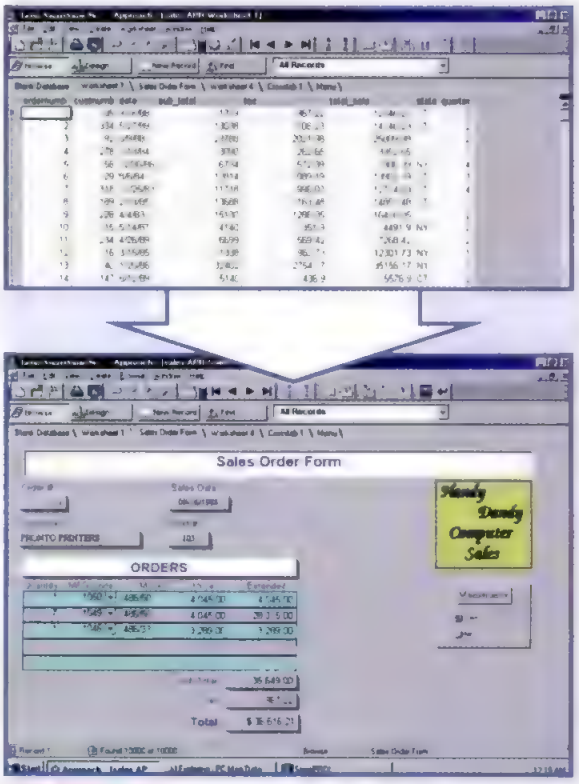
Database vendors have also realized that users need a simpler way to connect to organization-wide databases; consequently, they've provided enhanced connectivity to other database types, particularly to database servers. Most have joined Microsoft in supporting the Open Database Connections (ODBC) standard, which has emerged as the standard method for connecting to client-server databases. We've also seen increased support for Structured Query Language (SQL) as a native query language.

HIGHLIGHTS

Database Building Blocks

You may not be a programmer, but you'll look like one if you experiment with the wizards and templates found in today's end-user databases.

FAST ACCESS We were able to take the short route with Microsoft Access: With the Microsoft New Database Wizard, we readily accepted most of Access's defaults and quickly turned this complex table of information (above) into our simple but effective Mailbag interface (below).



GOOD APPROACH Though we could create a simple database front end just as easily with Lotus Approach as we did with Access, we decided to spend considerably more time tweaking the Lotus Approach template to build this application. Using tabs (all of which can be locked or hidden), you can gain quick access to the core data (above).

Many of these products have also improved their own data-handling capabilities to make it easier to create multitable relational databases and to incorporate graphics and other objects into the database.

In addition to the improved performance we've seen under Windows 95, database applications are making use of Windows 95's enhanced OLE to create sophisticated links between them and other Windows applications. Approach, for example, can act as an OLE container and server, so it can easily integrate a database with spreadsheets and documents.

Windows 95 also provides a built-in database replication mechanism: the Briefcase. While only Access explicitly supports it, any of the Windows 95–compliant products can use it to ensure that changes to one database are replicated to other copies on laptops or on other network servers.

DISCOVERY

We've found a suprisingly broad range of features and capabilities in these database packages. Though most guide you quickly and easily through the application development, others—like FileMaker Pro, R:BASE, and Wall Data's Salsa—take a more hands-off approach. Instead of wizards, they provide templates that you can use to create predefined databases, forms, and reports.

As organizations integrate standalone databases into enterprise-wide database systems, inter-database connectivity is becoming increasingly important. Some vendors have already begun addressing this, including Claris, whose FileMaker Pro has support for Macintosh databases, and Lotus, whose Approach has support for native database file formats (including Notes). However, none of these products let you produce standalone runtime versions, though some manufacturers sell add-ons that accomplish this task.

The big unknown is how the expansion of the Internet, and particularly the World Wide Web, will affect this class of products. Some vendors are working toward integrating their products seamlessly into the Web and providing sophisticated look-up capabilities via the Internet. For example, Approach includes Web browser capabilities that will automatically connect you to a site listed in a database.

Though this future may appear daunting to the uninitiated, those who do choose one of the products examined here should eventually find the possibilities exciting.

Lotus Approach 96 Edition
Microsoft Access for Windows 95

"Scary," "boring," and "unmanageable" are all words we've heard end users attribute to databases. Vendors heard them too, and responded. Two products in particular are transforming the end-user database market: Microsoft Access for Windows 95 and Lotus Approach 96 Edition.

If there's an effective database product that surpasses all others in ease of use, it's Lotus Approach 96. About a third of the price of Microsoft Access, Approach makes excellent use of a tabbed interface design, giving you instant access to your forms, data worksheets, crosstabs, and reports.

PC MAGAZINE EDITORS' CHOICE

Those familiar with Lotus's other products will find the same floating InfoBox. It lets you access and alter properties for forms, fields, or any object in your database on the fly. And a nifty Fast Format icon lets you quickly duplicate attributes across multiple objects. Approach has the power to take end users to the next level with Lotus's LotusScript programming language.

Microsoft Access is the most powerful end-user database product available today, and it's nearly as accessible as Approach. Wizards shield end users from much of the product's complexity. To help new users get into databases, Access maintains a rigid distinction between tables and forms, and it keeps all the parts of your database in a single easy-to-manage file.

No product takes better advantage of Windows 95. Access can keep multiple versions of your database (the one on your desktop, the one on your laptop) in synch via Windows 95's Briefcase feature.

Make no mistake about it: A lot of power rumbles under this friendly surface. Access can grow with your abilities, all the way up to database *programming* with Visual Basic for Applications. One important caveat: Access requires at least 12MB of RAM, and we found that it takes 16MB to make the interface fly.

Alpha Software Corp.

Alpha Five

At $49.95, Alpha Five 2, from Alpha Software Corp., is an undeniable bargain. With its extensive field rules, strong reporting, Genies (wizards), and more than 35 templates, you can create databases and full applications effortlessly and rapidly. A 32-bit Windows 95 application, Alpha Five will probably support Windows NT by the time you read this.

Alpha Five uses .DBF as its native file format. While it's fully compatible with a wide range of file formats, Alpha Five doesn't support SQL or ODBC. But the program's well-crafted, easy-to-use interface will appeal to new users, despite the interface's occasional inability to memorize the size and placement

Our Contributors: GREGORY ALWANG and TODD E. COLUMB are contributors to *PC Magazine*. RICHARD V. DRAGAN is a programmer for *PC Magazine*. STEPHEN W. PLAIN and JOE SALEMI are contributing editors of *PC Magazine*. DAN SMITH was the project leader, and LANCE N. ULANOFF was the senior associate editor in charge of this story.

END-USER DATABASES

How to Read the Suitability to Task Boxes

In this evaluation of end-user databases, we rate each database in six tasks typical to an end user. Where applicable, templates or wizards were used to automate the process. All tasks are rated for power and ease of use.

For our **general database** task, we look at how each database product creates new tables, interacts with existing data and structures, and imports records from an existing source.

Our **forms** task rates each database application on its ability to create a set of data entry screens. Accordingly, we take into account query design mechanisms, form generators, and templates.

SUITABILITY TO TASK

Product name

	Power	Ease
General database	Excellent	Excellent
Forms	Excellent	Excellent
Query and analysis	Good	Good
Reporting	Fair	Fair
Rapid application development	Poor	Poor
Connectivity	N/A	N/A

The **query and analysis** task looks at the database's ability to help end users formulate simple or complex queries.

In the **reporting** task, we evaluate the product's ability to create billing statements, sales reports, mailing labels, and external and internal mail merges from the data set. We also evaluate analytical tools such as crosstabs and charts.

The **rapid application development** (RAD) task tests how well each end-user database package can quickly and efficiently build a front end that integrates the data and various features of a program into an application.

We also evaluate the **connectivity** features for each end-user database package, which include accessing data across a network as well as accessing data from a SQL Server.

of dialog boxes within forms.

Alpha Five's New Object Genie guides you through the necessary steps to create a table. You can choose one of the program's templates, which include predefined field rules, forms, and reports. This lets you build simple but complete applications. Besides the standard field types, you can also create .BMP, OLE, and Rich Text Memo fields.

The program's extensive field rule options include validations, masks, lookups, postings, and some esoteric field rules such as double entry (which automatically requires the user to enter the data twice). Calculated validations can include a built-in function, for example, that validates credit card numbers. You can also create auto-increments for numeric, data, *and* text fields. In addition, Alpha Five's powerful posting rules allow you to post data conditionally from one field to another in any table (related or not). Many of the rules, including postings, offer custom settings as well.

DATA FOX

Alpha Five adeptly employs the FoxPro index format. When you define an index (the program doesn't create an index automatically), you can select multiple fields; simply select numeric fields and Alpha Five automatically inserts an appropriate STR() function. You can also specify a primary index and rebuild all indexes with one mouse click.

Establishing relations also requires little expertise. The New Object Genie expertly guides you through the task of creating a set of related tables. After you select the tables and link fields, Alpha Five displays the relations graphically. You can add more relations to the main table or related tables. Alpha Five creates a default form for each table and set. The default form for a set even includes the child records in scrollable tables, a nice touch that saves you design time later on.

The New Object Genie also provides step-by-step help for creating new forms. You can use the default form as a starting point for your own custom form. Alpha Five enforces any predefined field rules wherever the field is in use (in forms, browses, and so forth). Like Microsoft's Access, Alpha Five has the invaluable time-saving ability to define field masks, templates, validations, and lookups at the table level.

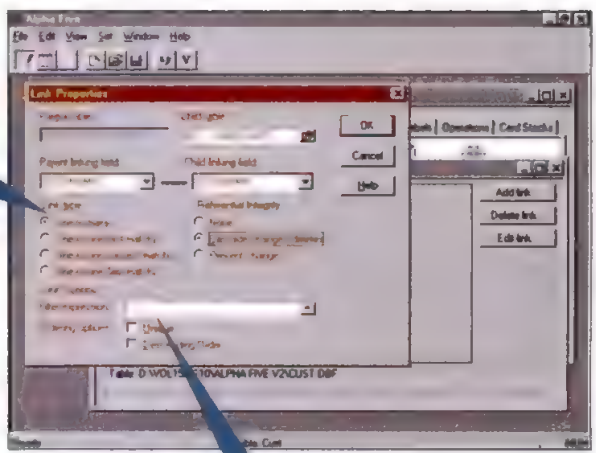
When defining relations in Alpha Five, you can use one-to-many or various one-to-one link types

CUSTOM MENUS

You can create custom menus by attaching a form to any table in a database and setting it to open automatically whenever you load that database. You can also build buttons that open other forms or perform database operations. One report option lets you decide whether to use the current order and filter or to specify a new order.

Alpha Five easily performs queries with its Query by Form, Query by Table, "find text" and "find by" keys, or optimized queries. Alpha Five conducts sorting with either an index or a "quick sort," or as part of a query.

Alpha Five supports custom reports, labels, and form letters, but not charts. You can create labels using Alpha Five's library of Avery and NEBS label formats. You can also perform internal mail-merges or export your data for mail-merges with outside applications.



Relations can also include a filter expression to create a subset of records

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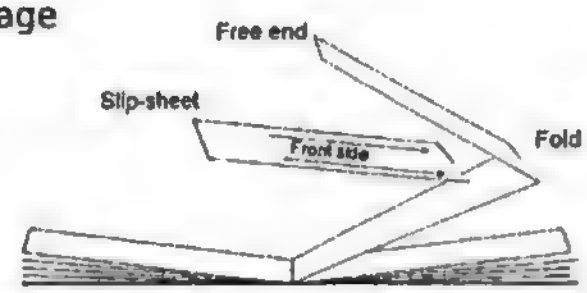
Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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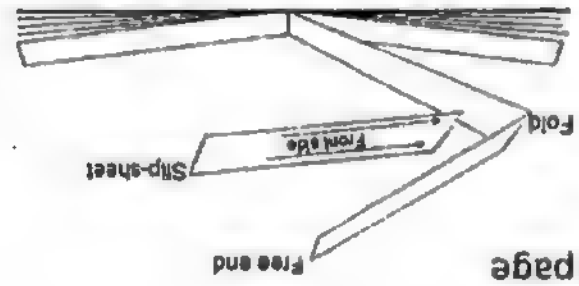
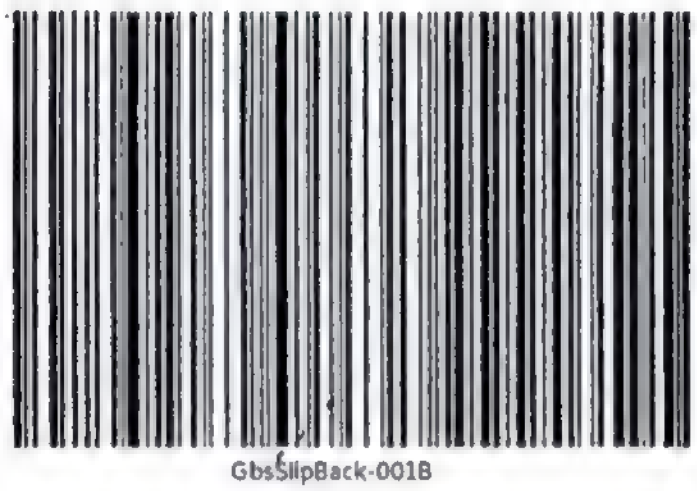
3. Slice the folded edge
4. Close the page and slip-sheet





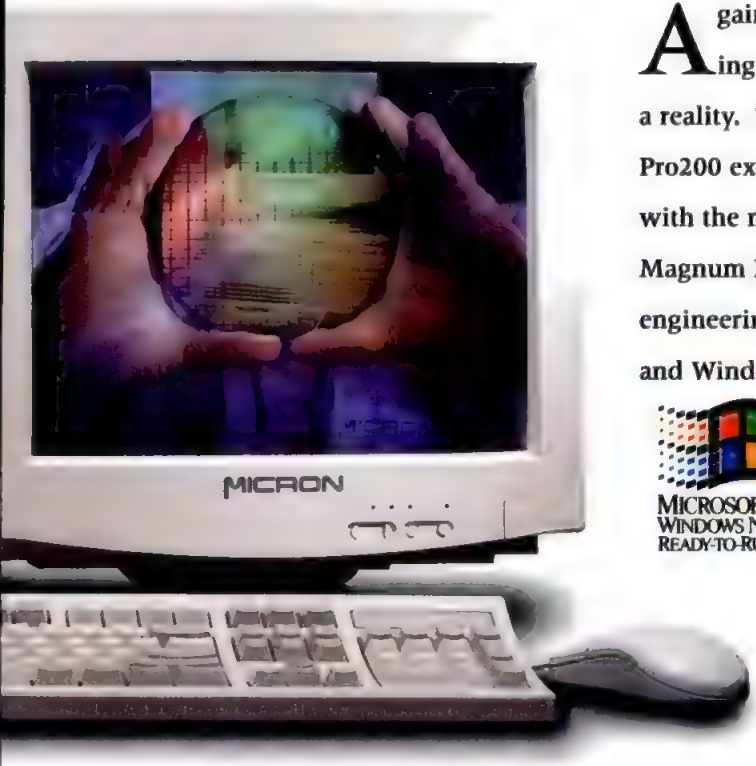
Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

PRO MAGNUM



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- Microsoft Windows® 95 CD & MS Plus! CD
- Microsoft Home Pak includes: Works 4.0 for Windows 95; Publisher Deluxe for Windows 95; Encarta® 96; Encarta 96 World Atlas; Music Central™ 96; Wine Guide; Arcade 1.0; Scenes–Sports Extremes Collection; Cinemania® 96; Julia Child Home Cooking; Best of Windows Entertainment Pack; Money 4.0 for Windows 95; CD Sampler (includes Fury³ game demo)
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- Microsoft Home Pak includes: Works 4.0 for Windows 95; Publisher Deluxe for Windows 95; Encarta 96; Encarta 96 World Atlas; Music Central 96; Wine Guide; Arcade 1.0; Scenes–Sports Extremes Collection; Cinemania 96; Julia Child Home Cooking; Best of Windows Entertainment Pack; Money 4.0 for Windows 95; CD Sampler (includes Fury³ game demo)
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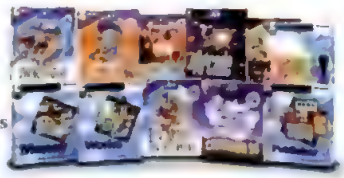

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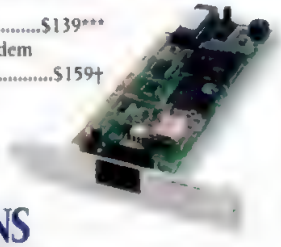

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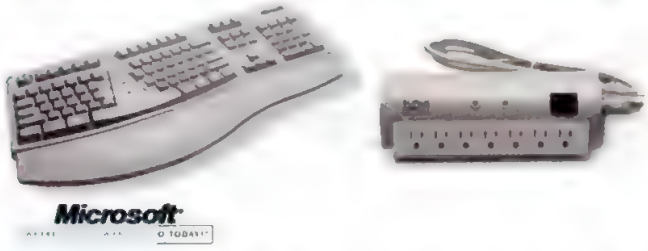

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SUITABILITY TO TASK

Alpha Five

	Power	Ease
General database	Good	Good
Forms	Good	Good
Query and analysis	Good	Good
Reporting	Good	Good
Rapid application development	Fair	Good
Connectivity	Fair	Good

All custom databases can be shared over the LAN, and Alpha Five's support for concurrent users is limited only by your network's abilities. And though all networked users need their own copies of the product, Alpha Five's three-user pack ($70) costs less than most other products' *additional* licenses.

In this version of Alpha Five, you won't find extensive macro or scripting capabilities. But look for a full-featured developers' version, which uses Visual Basic–like syntax, scheduled for release this summer.

A competent end-user database, Alpha Five 2 impressed us with its powerful field rules and full relational support. On the other hand, its lack of SQL and ODBC support as well as a couple of frustrating interface flaws may discourage some users.—*Todd E. Columb*

Alpha Five 2. Estimated street price: $49.95. Requires: 486-based PC or better, 12MB RAM, 15MB hard disk space, Microsoft Windows 95. Alpha Software Corp., Burlington, MA; 800-451-1018, 617-229-2924; fax, 617-272-4876; http://www.alphasoftware.com. *Circle 441 on reader service card.*

DataEase International Inc.

DataEase for Windows

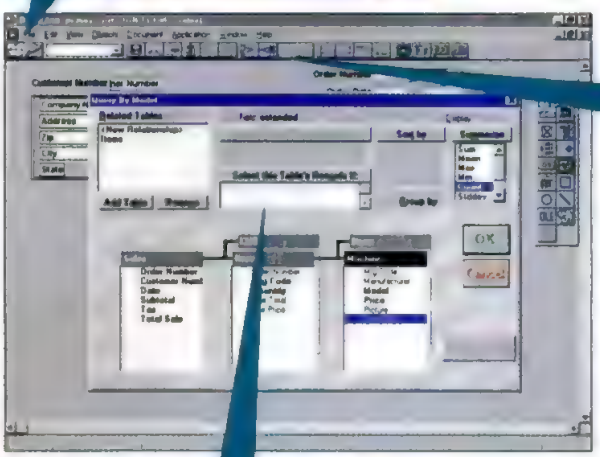
DataEase 5.11 for Windows ($495) is an ineffective migration of the company's veteran DOS database product. Although designed for both end users and longtime developers of DataEase for DOS, the 16-bit Windows product is far from user-friendly. DataEase exhibited a less productive environment than that found in most of the other databases we tested, and it required coding for even the simplest tasks in our testing script. DataEase uses its own proprietary format but can access AS/400, dBASE, DB2, Oracle, Paradox, SQL Server, and Sybase formats via ODBC if you provide the appropriate drivers.

DataEase's consistent toolbars emerge as the product's most welcoming feature. You can instantly switch between Design and User views to test your changes immediately. When you open or create an application, DataEase presents the Catalog, a container window of the application's Tables, Menus, Forms, Reports, and Procedures. DataEase blurs the distinction between forms and tables by eliminating the usual step of defining tables before using them for forms. When you create a new form, the program creates the table automatically as you place fields on the form, and when you draw a new field, the field definition window appears.

FIELD WORK

The field definition window lets you define all of a field's characteristics, such as type, length, index settings, security, display characteristics, derivation formula (if it's a calculated field), validation formula, and custom help messages. Though efficient at times, often this compact all-in-one dialog made us search in vain for ways to restrict data without coding. For example, to restrict a state field to two alphabetic characters, we had to write a validation formula to test each character for a range from A to Z. And because DataEase's date format is global to the entire product, we couldn't change the display format for date fields.

In DataEase for Windows, you can quickly switch between User and Design views by clicking the appropriate toolbar button.



One of DataEase's most notable features is its graphical zoom feature. You can zoom in and out from your forms and reports in both Design and User views.

The Query by Model dialog lets you quickly build multiple table forms and reports through point and click.

DATA UNEASE

We ran into our first stability problems with the product when we imported data into our customer table. The product crashed on us several times as we switched between Design view and User view to browse our table. We determined that this was related to the size of the memo field we defined, and the vendor confirmed this as a reported bug. Our problems with this memo field were not yet over, however; when we imported from a dBASE table, the memo field incorrectly read the data. The vendor also confirmed this bug, so we finally resorted to importing from a text file.

We used the product's Query By Model interface to define our multitable forms and reports. Query By Model is DataEase's query builder that lets you pick tables and fields, define sorting and grouping, and establish summary calculations by pointing and clicking. This dialog is easy to use but we found the Expression Builder—the pop-up window that lets you create selection and filter formulas—weak at syntax checking.

While DataEase helped us get started with our multitable forms, it did little to help us finish them. The product lays out the various subforms and groupings with thin boxes. We had great difficulty positioning these boxes and the fields they contained, especially when we attempted to align fields from separate groups. Our sales order form presented the biggest stumbling block. While most products allowed us to simply multiply the quantity field from our items table with the price field of our products table to create line totals, DataEase refused to cooperate. According to technical support, you must define

Microsoft Visual Tools

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- Components
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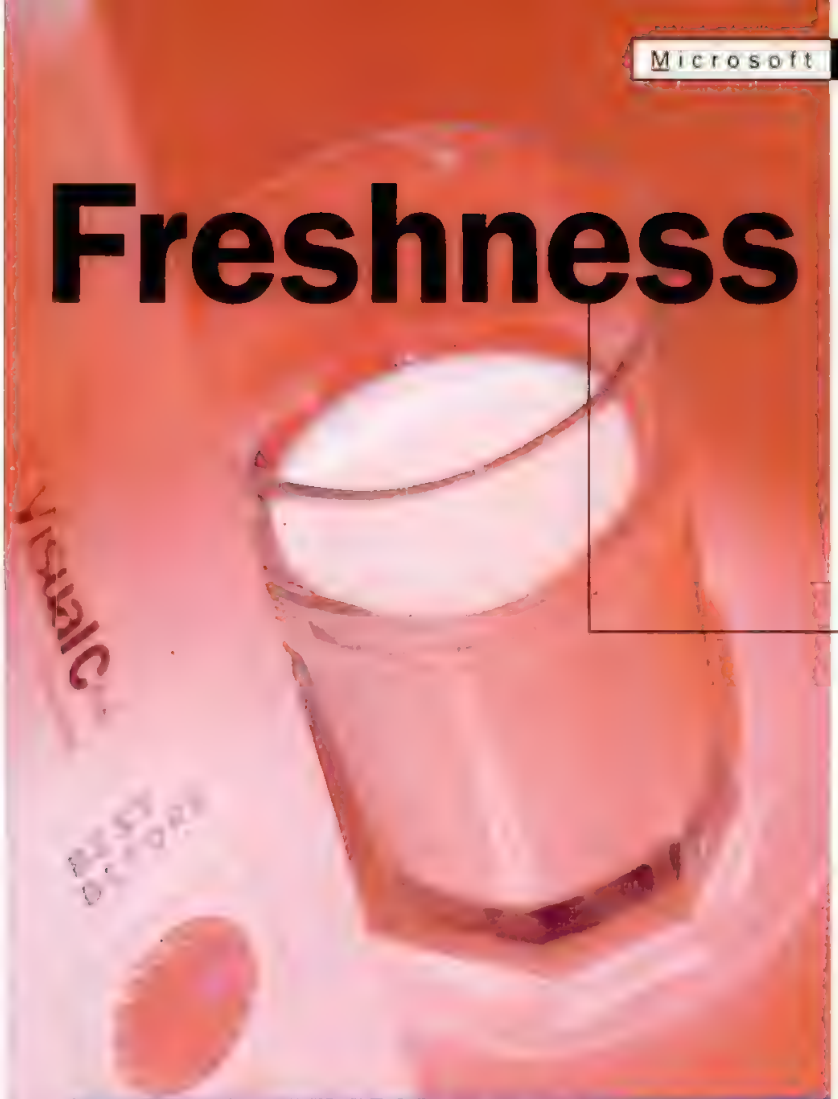

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a virtual field for one table with a lookup formula to the other.

We ran into similar layout problems with our reports and experienced some unexpected results. Although the product includes a WYSIWYG report and form designer, the vertical lines in our printed reports were erratically spaced.

NO GRAPHING

DataEase does include different styles of reports, including free-form, banded, columnar, and mailing labels. However, the product lacks a functional graphing feature (though the documentation and menu items claim otherwise) as well as crosstab support. DataEase explained that the graphing feature was recently removed because it was buggy. We had no problem creating mailing labels or basic tabular reports, but our progress slowed down tremendously when we moved on to our billing statement—a report that required some summarization, conditional text, and precise formatting. Again, we had to resort to coding several formulas.

SUITABILITY TO TASK

DataEase for Windows

	Power	Ease
General database	Fair	Fair
Forms	Fair	Fair
Query and analysis	Fair	Good
Reporting	Fair	Fair
Rapid application development	Good	Fair
Connectivity	Good	Good

DataEase for Windows has not progressed much since its short-lived predecessor, DataEase Express for Windows, moved the company's established program into Windows. The product still seems unfinished and unrefined, and its underlying scripting language is not event-driven, so it can't merge well with the event-driven Windows environment. In its current state, DataEase for Windows simply can't compete with the leading end-user databases.—*Stephen W. Plain*

DataEase 5.11 for Windows. List price: $495. Requires: 386-based PC or better, 4MB RAM, 10MB hard disk space, Windows 3.1 or later. DataEase International Inc., Trumbull, CT; 800-243-5123, 203-374-8000; fax, 203-365-2317. *Circle 443 on reader service card.*

Designer Software Inc.

DBExpert

Designer Software's DBExpert 2.0 ($149) provides an easy-to-use interface and good connectivity to multiple database sources, presenting an appealing database solution for small business users working in OS/2.

DBExpert uses a central object manager window and an OS/2 notebook control to organize all the elements in your database application. Clicking on the Tables tab brings up a list of available tables or allows you to create new tables in your database. Fields supported include Text, Memo, Number, Counter, and Bitmap. As you create tables, DBExpert searches the other tables in your database for matching field names and forces you to use the same data types when creating links between tables.

The default database type in DBExpert is the dBASE IV .DBF file format using ODBC. For better performance, native non-ODBC access is available for connecting to standard DB/2 databases. DBExpert lets you combine database types within the same applications and view local and remote tables side-by-side. You can also import and export .CSV and dBASE IV files, though importing more than 1,000 records at the same time proved very sluggish—DBExpert performed third from last in almost all our tests.

BUILD A QUESTION

The Query Designer tool in DBExpert, which looks and works like Microsoft Access's Query, is one of DBExpert's most appealing features. The Query Designer gives you excellent control, letting you add tables and columns interactively using the mouse. Just double click columns to add them to a spreadsheet. In addition, you can join tables by dragging a field from one table to another field in another table, and you can choose sorting conditions, as well as calculated and total fields.

To create views, forms, and reports, you first design queries. DBExpert's view module is also a winning feature. Once you create and open a view, you can add and edit records in spreadsheet format, search for values using full and partial matches, and perform mass updates on entire columns. For example, we effortlessly browsed a query with 50,000 records.

SUITABILITY TO TASK

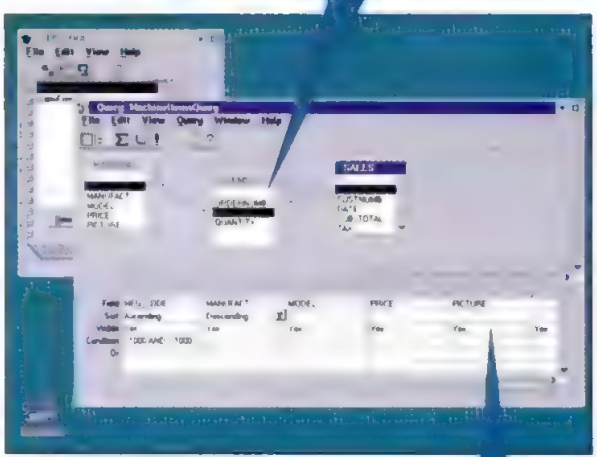
DBExpert

	Power	Ease
General database	Good	Good
Forms	Good	Good
Query and analysis	Good	Excellent
Reporting	Good	Good
Rapid application development	Good	Good
Connectivity	Fair	Good

DBExpert lets you easily convert a query into a form with its Quick Form option. The interface for the form designer also resembles that found in other packages. You can add and arrange controls, including bitmaps, simple bar charts, pies, and line graphs within forms. Validation rules for data, such as range checking and formatting options, are easily added by changing the settings for each field. You also can attach code to events for a particular control, such as entering and leaving a field. But to add detail records to a master view, you need to embed one form within another form, and join them on a field—not an easy task for inexperienced users.

The report designer in DBExpert gets good marks for ease of use, at least for simple report types. For one thing, you

DBExpert lets you connect tables visually and double-click to choose fields to your query



You add sorting and data selection criteria in this table-like form

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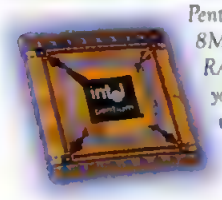

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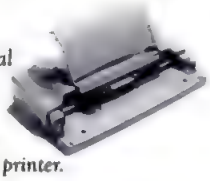

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PERFORMANCE TESTS

End-User Databases

In general, Microsoft Access and Microrim's R:BASE's database engines outperformed most competitors. On the other hand, Wall Data Corp.'s Salsa was quite slow, and Claris's FileMaker Pro kept up with the other databases when querying indexed fields but did poorly on all tests involving nonindexed fields.

What the Numbers Mean

To examine the performance of the nine end-user database products, we created five tests: filter on an indexed field, filter on a nonindexed field, update on an indexed field, update on a nonindexed field, and auto report.

Our **Filter on an Indexed Field** test measured how quickly each package searched on an indexed field within a 61,441-row table based on a specific selection criteria that returned 1,054 records. Our **Filter on a Nonindexed Field** test queried the same table on an unindexed numeric field that returned 19 records.

In our **Update on an Indexed Field**, we queried the 61,441 record table based on the value of two fields that modified 83 records: the key field and a nonindexed field. The key field in the result set is then updated. Wherever possible, we attempted to perform the query and update in a single step. In a few cases, we had to first perform the query and then run an update. Our **Update on a Nonindexed Field** test queried a single nonindexed numeric field and updated this field in the resulting query set, modifying 63 records.

Finally, our **Auto-Report** test measured how quickly the database could generate a standard columnar report that returned 63 records. To produce the report, the package must return a subset of the data based upon a joining of two tables on a key value. The results are then printed to a file on the workstation. Most of the products performed the query and report in a single step, but a few programs required that the query set be performed first. Then they generated the report from that set; in these cases we combined the time of the query and the report.

Microsoft Access performed quickly with 8MB of RAM. (Since Microsoft Access's literature states that it *requires* 12MB of RAM, we also tested under that configuration. Its database engine performance was slightly better than it was with 8MB, and the application's responsiveness was vastly improved.) But while the queries and reports produced reasonably fast results under 8MB, the overall performance of the product, such as the time to bring up dialog boxes or to walk through Wizards, was intolerably slow.

As expected, Lotus Approach 96's nonindexed searches were noticeably slower than its indexed searches. However, Approach's SmartIndexing feature creates an index the first time you query an unindexed field. Therefore, all subsequent queries on the field will be considerably faster. Although the size of the files may increase substantially, most users probably won't mind, and the benefits of indexing these fields will likely outweigh the risks. For our testing purposes, we deleted the index created by Approach before rerunning the test.

Although we ran the two 16-bit applications, DataEase and Salsa, under Windows 95, neither took advantage of Windows 95's enhancements. In fact, on our update on a nonindexed field test, DataEase's and Salsa's performance worsened under Windows 95: When querying fields that are unindexed, DataEase creates a temporary index on that unindexed field, which can lead to high overhead. In Salsa's case, it assumes that you plan to modify the data and pre-processes all records. Under Windows 95, both these programs suffer from slow input/output (I/O) operations. But both products do benefit from Windows 95's print spooler.

DBExpert, the only OS/2 database in this roundup, performed below average in all our tests, compared to the other packages. Although all query operations are threaded, if the field is nonindexed, DBExpert has to scan the entire table to filter the fields that are indexed. In DBExpert, the tests for filter on a nonindexed field, update on an indexed field, and update on a nonindexed field required the resulting set to come from either an unindexed field or both indexed and unindexed fields. DBExpert's performance in indexed fields was significantly faster than the nonindexed tests. But compared with its competition, DBExpert's indexed operations performed poorly (probably because of OS/2's overhead).

For our update on an indexed field test, we couldn't test Salsa because it can only search and replace based on a single field, and our tests queried on two fields. In addition, Salsa requires constant toggling back and forth between the various modules of the product to refine the application design. Although Salsa's interface exhibited a fresh concept in the database market, the program's limitations make it unacceptable for actual database usage on anything but a fast Pentium with at least 16MB of RAM (a

can reuse views as reports (though you'll probably need to customize them further). Although DBExpert doesn't reference Avery label types by number, it supports common label sizes and can define custom label sizes. You can also print preview and easily add fields, graphs, calculated fields and totals, as well as detail records. However, more advanced reporting, such as crosstabs, requires some programming. The product also lacks a built-in mail-merge capability.

For more advanced development, DBExpert uses OS/2's powerful REXX programming language along with approximately 100 functions that let you perform database functions from within your code. You can attach macro code to a variety of form and control events, so that processing can occur before and after edits or record updates, for instance. Unfortunately, DBExpert doesn't let you change or design custom OS/2 menus, so you'll probably resort to creating buttons to simulate menu choices.

The well-written manual that accompanies DBExpert offers a simple introduction to the product, including how to get the most out of REXX. The easy-to-read tutorial book guides you carefully through the design of your first database, so that it's up and running in a few hours. Once you've built your application, you

system on which we did not test). Salsa also won't return more than 16,000 rows at one time, although our tests didn't exercise this limitation.

Although tests on indexed fields in Paradox produced average results, performance deteriorated when any query depended on a secondary index. R:BASE led the pack in our auto report test: It prepares the data internally with its proprietary engine and then processes the data to a Windows print job on a band-by-band basis. DataEase also accomplished this task exceptionally well, using standard Windows API calls to the print spooler.

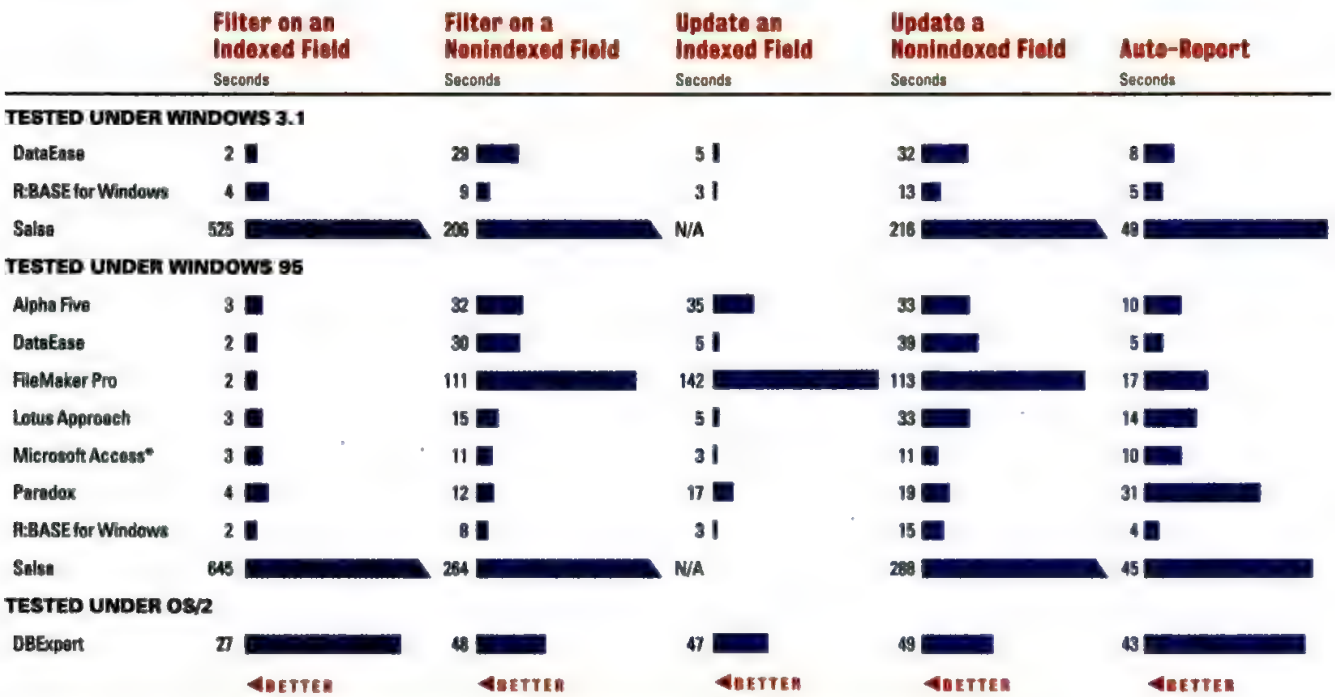
How We Tested

The data in our end-user database tests consisted of a subset of the Consumer Price Index (CPI) called All Urban Consumers. We retrieved the data from the Bureau of Labor Statistics' Web page at *http://www.bls.gov*, where it is available in a form ideally suited for such testing. Most of it is actual CPI data in time series form identified by a mnemonic, and other databases are available for decoding those mnemonics. The data set consisted of five interrelated tables with one-to-many relationships. Four of the tables had an index on the primary key field.

We tested three programs—DataEase, R:BASE, and Salsa—under Windows for Workgroups 3.11. (The 32-bit R:BASE required Win32s.) In addition, we tested all Windows applications, both 16-bit and 32-bit, under Windows 95. DBExpert, the sole OS/2 product in the group, was tested under OS/2 Warp Connect 3.0. We created the data set from comma-delimited ASCII and dBASE III format. All products were installed using the defaults of the package.

For the Windows for Workgroups 3.11 products, we used MS-DOS 6.22 with SmartDrive write-behind caching disabled and a permanent swapfile with 32-bit disk access enabled. Windows 95 didn't require any optimizations. We timed tests from the moment the button or menu item was selected until the product returned the answer or control to the user. We ran all tests three times to ensure consistency and accuracy.

If the program provides some sort of automation process to perform a task, such as a wizard, we started timing the task as soon as the program completed its automation. For the programs that provide such automation, we only used it to form the parameters for the test, not to perform lookups or modifications of the data.
—Analysis written by Dan Smith



* The Microsoft Access database engine was slightly faster when we tested it with 12MB RAM, as the product officially requires. N/A—Not applicable. The product cannot perform this task.

can easily put the database on a network and share the data with other users. A separate runtime version of DBExpert ($29) lets you distribute your applications to other users.

DBExpert is an admirable database solution that packs a lot of usable functionality into a small area (about 5MB hard disk space). In an era of ever-larger programs, a package this thrifty (in terms of design) has its appeal. If the relative dearth of usable nonprogramming database design tools for OS/2 has frustrated you, take a close look at DBExpert.—*Richard V. Dragan*

DBExpert 2.0. List price: $149 ($49 upgrade). Requires: 386-based PC or better, 4MB, 5MB hard disk space, OS/2 2.0 or later. Designer Software Inc., Fruita, CO; 800-519-9574, 970-858-0200; fax, 970-858-3313; http://www.dbexpert.com. *Circle 442 on reader service card.*

Claris Corp.

FileMaker Pro for Windows 95

Claris FileMaker Pro 3.0 for Windows 95 ($199) is a capable data integration program that allows users on Macintosh and Windows 95 platforms to share data simultaneously. In this latest release, you'll also find improved field definitions, relational abilities, un-

CRITICS CALLED IT "VIRTUALLY FLAWLESS."

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"...ght screen, superior on-screen controls and low price."

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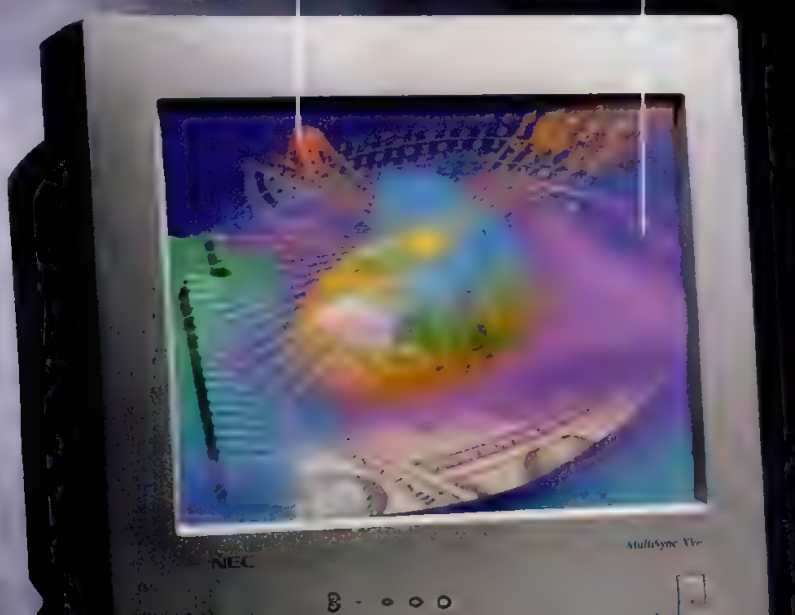
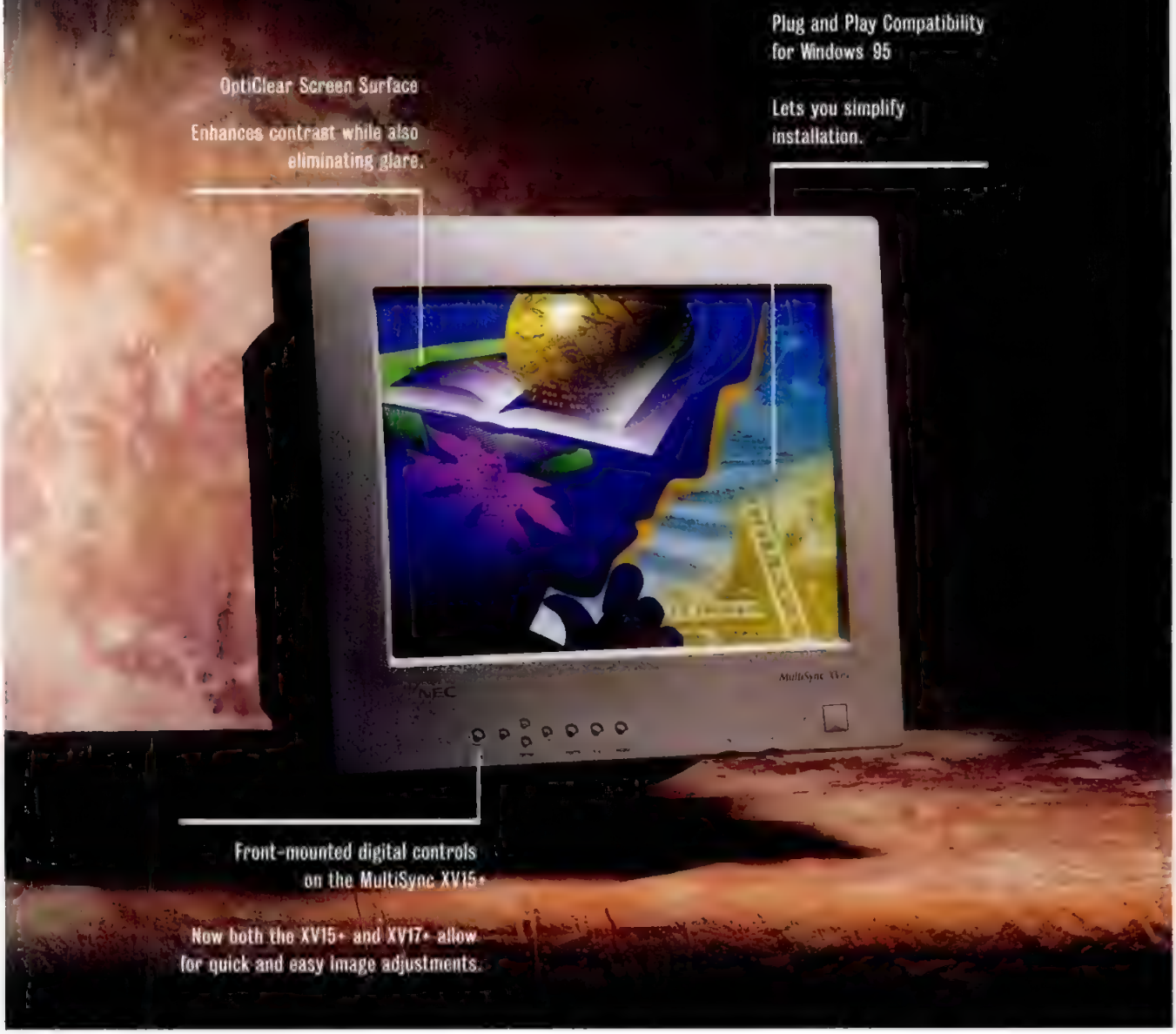


THAT SCATHING REVIEW LED US TO THESE IMPROVEMENTS.



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The MultiSync XV+ Series also delivers the quality and reliability you expect from NEC, and is backed by a 3-year limited warranty.

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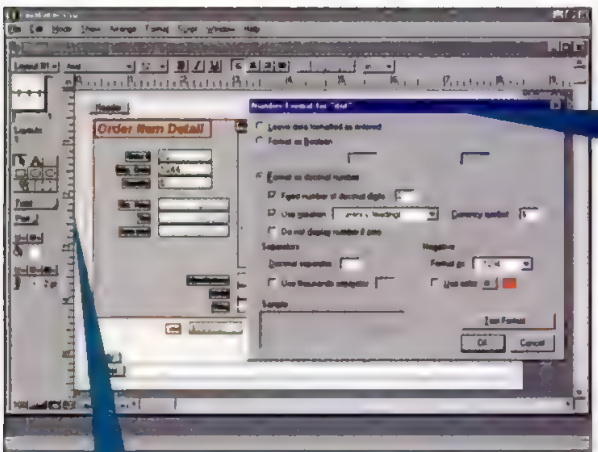
CIRCLE 157 ON READER SERVICE CARD

limited file size, and OLE 2.0 support.

FileMaker Pro, a 32-bit Windows 95 and Windows NT 3.51 application, provides automatic data format conversion from its prior Windows 3.1 version, 2.1.



Numeric field display options allow for a wide variety of formats.

FileMaker Pro's tools palette, available during Layout mode, provides access to all available functions.

But the formats are not compatible, so you can't share a database between the two. FileMaker Pro accomplishes Mac/Windows data sharing via built-in IPX/SPX or TCP/IP protocol support.

FileMaker Pro imports and exports data from .DBF, Lotus 1-2-3 files, and basic text formats very slowly. But the program supports advanced table definition field types: A Summary field calculates sub-totals, averages, and grand totals across a group of records. You can use global field types as a variable, accessing them in conditional scripts and by all records. In addition, FileMaker Pro supports OLE through container fields that can hold graphics, sounds, and video.

FileMaker Pro's improved field rules now allow you to define auto-enter values based on the previous record or on a calculation from a user defined calculation in the field definition. You can conveniently perform other validations against user-defined value lists or those from another table, as well as edit your value list without interrupting your data entry. Indexing is automatic by default, but you can handily enable or disable it on each field. FileMaker Pro also comes with more than 40 professional-looking, data-filled templates and sample files.

FileMaker Pro lets you establish multiple relations between tables from one controlling table, but you can't use indirect relations or fields from a third-table or *grandchild* relation in layouts. When you delete the controlling record, the program deletes the related records. If you choose, you can enable or disable the ability to create new records in a related table.

FileMaker Pro uses layouts for viewing, editing, and printing databases. A drop down list box displays all available layouts, which serve as both forms and reports. But FileMaker doesn't support input masks, and only a few display formats exist for numbers and dates. You can force text field contents to accept only upper- or lower-case input. Unfortunately, FileMaker has grouped this option with other font styles and not with the field's format properties.

While Macintosh users may benefit from FileMaker Pro's interface, Windows users will probably find it a drawback. For example, several commands don't appear where a Windows user would expect to find them: To delete a record, you have to look under the Mode menu—not under Edit—and no Record menu exists. At least the contents of this Mode menu change intelligently, depending on whether you select the Browse, Layout, Find, or Preview mode.

To create custom application forms in FileMaker Pro, you build a layout with buttons to activate other predefined layouts. Using this technique, you can switch between modes to automate data entry and printing reports. Although you can create buttons quite simply, you can only change the script from which a button executes if you recreate the button from scratch.

FileMaker Pro's Find mode places you into a Find by Form screen that lets you enter data into any of the fields. You can stack multiple Find requests to create complex queries. In our testing, for example, we selected all customers in the Northeast by entering a separate Find request for each state. Though this method required many steps, it produced the desired result. Once you find the records you want, you can easily step through the records. Note that in any view the found records remain selected until you use the Select menu and choose Find All.

Choosing from the provided list of Avery and CoStar label format libraries, you can readily create labels in FileMaker Pro. But its relational constraints hinder multitable report creation ability: When creating our database application, FileMaker Pro would only let us include fields from the controlling table or fields from a directly linked table.

FileMaker Pro lacks built-in charting, SQL capabilities, and the ODBC support that many of the other products reviewed here include. Though ideal for environments with both Windows 95 and Macintosh workstations, Claris's FileMaker Pro 3.0 for Windows 95 ultimately best suits users with simple database needs. For advanced programming, reporting, and relation capabilities, look elsewhere. —*TEC*

SUITABILITY TO TASK

FileMaker Pro for Windows 95

	Power	Ease
General database	Fair	Good
Forms	Fair	Fair
Query and analysis	Good	Fair
Reporting	Fair	Fair
Rapid application development	Fair	Fair
Connectivity	Fair	Good

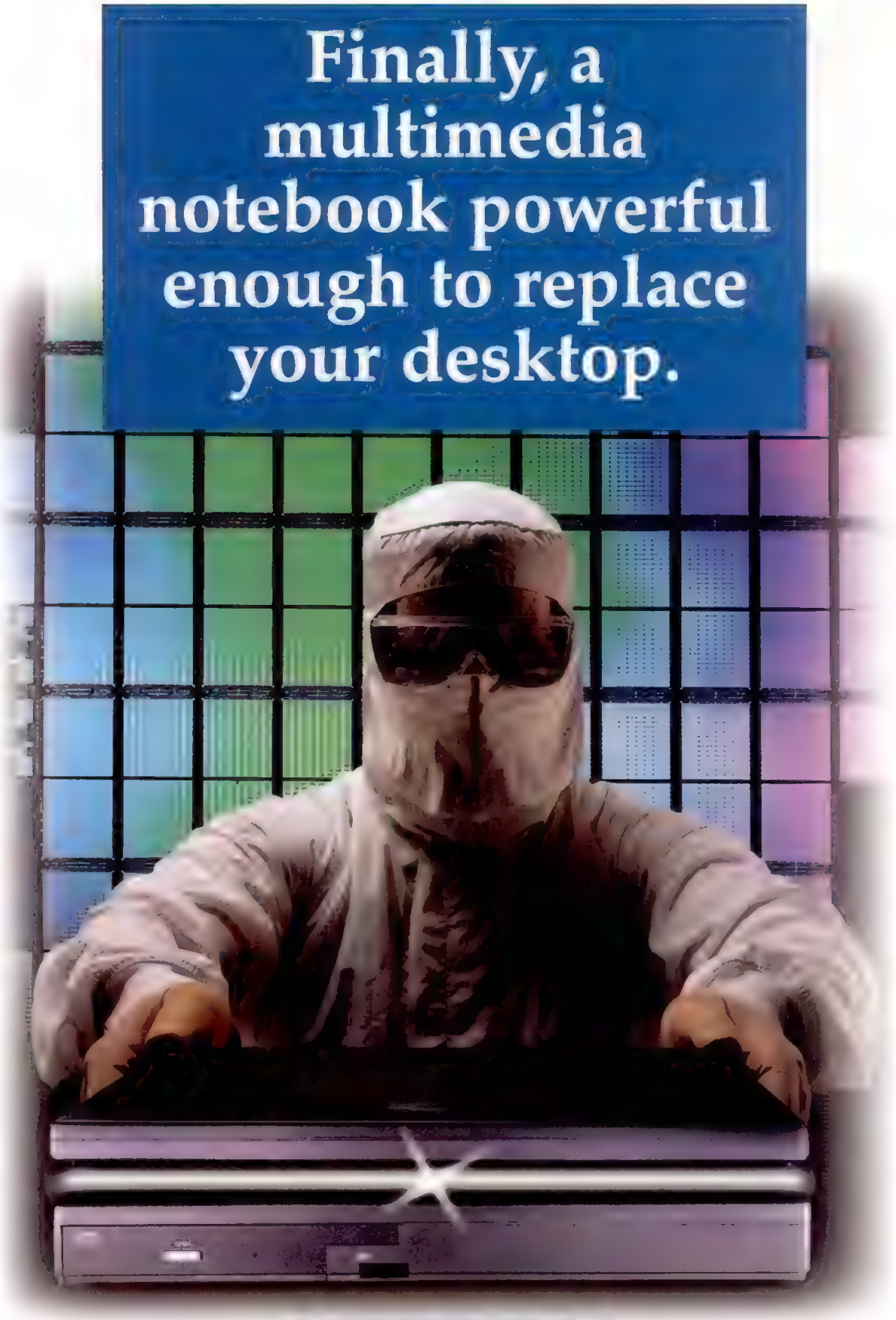
FileMaker Pro 3.0 for Windows 95. Estimated street price, $199. Requires: 386-based PC or better, 8MB RAM, 4MB hard disk space, Windows 95 or Windows NT 3.51. Claris Corp., Santa Clara, CA; 800-544-8554, 408-727-8227; http://www.claris.com. *Circle 444 on reader service card.*

Lotus Development Corp.

Lotus Approach 96 Edition for Windows 95

PC MAGAZINE EDITORS' CHOICE

Lotus Approach 96 Edition for Windows 95 ($105), from Lotus Development Corp., continues its tradition of combining ease of use with a powerful data-access engine. Compatible with previous versions, this new 32-bit version provides a complete relational database management environment that any nonprogrammer can use to develop sophisticated applications.


Finally, a multimedia notebook powerful enough to replace your desktop.
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The Millennia TransPort™

PC Magazine **reports in its November 21, 1995 issue,** ***"By all accounts...Micron's Millennia TransPort P133 is nearly a dead ringer for IBM's ThinkPad 760CD, but performs better and saves you about $2,500."***

PC World **reports in its March 1996 issue that,** ***"...this Pentium 120 ran the new PC WorldBench tests faster than any other notebook we've measured...."***

The April 1996 *Windows Sources* says, *"The Millennia TransPort, a bench-burner of a notebook...delivered the highest Winstone 96 score we've ever seen on a notebook: 53.3."* Feature for feature this notebook gives you everything you need—whether you're working on the road or at your desk. According to *PC World*, *"If you have a 75, 90, or 100MHz Pentium PC on your desk, it will fairly crawl compared to Micron's Millennia TransPort."*
—*PC World*, March 1996

Performance that will take you where you want to go!
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—*Windows Sources*, April 1996

Start with blistering speed—133MHz mobile Intel Pentium® processor—add 256KB of pipelined burst cache and 16MB EDO memory and you've got all you need to conceive and execute the most sophisticated multimedia presentation.

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The March 1996 *PC World* says, *"If you believe this notebook is only for engineers or lucky CEO's, think again...."* Go with the notebook that outperforms the rest—the Millennia TransPort from Micron.

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Dual Infrared Ports provide convenient IRDA-compliant wireless connection in front or in back.

Two PCMCIA Slots hold either two Type II or one Type III device. Handles a wide variety of communications and storage options.

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or

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Intelligent lithium-ion battery

or

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Desktop Ready!

"An excellent entry into the mobile Pentium fray, Micron's Millennia TransPort offers a solid blend of features, performance, and design."
—*Windows Sources*, April 1996

Specifications

Common Features
- 133MHz Mobile Intel Pentium® processor
- Intel 430MX PCIset
- 256KB L2 pipelined burst cache
- EDO memory (48MB max.)
- 4X modular CD-ROM drive
- 11.3" SVGA color display, 800 x 600
- PCI graphics accelerator, 1MB RAM
- Pick-a-Point™ dual pointing devices integrate both pointing stick and touchpad
- Removable EIDE hard drive (1.2GB max.)
- 3.5" modular floppy drive
- Intelligent modular lithium-ion battery
- SoundBlaster™ 16-bit stereo sound
- Built-in stereo speakers and microphone
- 2 Type II or one Type III PCMCIA slots
- S-Video and NTSC video-outputs
- Headphone, microphone and line-in jacks
- 2 infrared ports, one front, one back
- Parallel, serial, VGA and 2 PS/2 ports
- Dimensions: 11.7" x 9.4" x 2.0", Weight: 6.9 lbs.†
- Nylon carrying case
- Microsoft® Windows® 95 CD & MS Plus! CD
- Microsoft Office Pro 95 and Bookshelf 95 CDs
- 5-year/3-year Micron Power℠ warranty*

Micron Millennia TransPort P133
- Intel 133MHz Pentium processor
- 11.3" active matrix color display, 800 x 600
- 32MB EDO memory (48MB max.)
- 1.2GB removable hard drive
- 2nd intelligent modular lithium-ion battery
- Motorola® Montana 28.8 fax/modem

$5,799 Business lease $182/month

- Intel 133MHz Pentium processor
- 11.3" active matrix color display, 800 x 600
- 16MB EDO memory (48MB max.)
- 1.2GB removable hard drive
- 2nd intelligent modular lithium-ion battery

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†6.9 lbs. includes 3.5" floppy and one battery.

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Options

- **MicronDock™ multimedia port replicator**
  Ethernet LAN adapter, SCSI-2 port, S-Video and NTSC video outputs, built-in stereo speakers, infrared port, headphone, microphone, line-in jacks, parallel, serial, VGA and 2 PS/2 ports.....**$299**

- **MicronExec™ desktop package**
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  Matching black mouse and keyboard (can be used with or without MicronDock).....**$799**

- Motorola Montana 28.8 fax/modem supports regular telephone connections, cellular phones and two-way paging devices.....**$299**
- 2nd intelligent modular lithium-ion battery.....**$199**
- 2nd 1.2GB modular hard drive (2.4GB total).....**$599**
- 16MB EDO memory upgrade.....**$699**
- Leather carrying case upgrade.....**$ 59**

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TRNS-PCMG-9605B

Approach 96's intuitive interface puts everything at your fingertips. You can access all forms, reports, worksheets, and charts from tabbed pages, so you can easily switch between data views. The Action Bar keeps commonly used menu items, such as adding or finding a record, a mouse click away.

Throughout the process of building forms and reports, the floating InfoBox (also in Freelance, Lotus WordPro, and Notes 4) provides a one-stop access point for modifying attributes of any object or field. You also use the InfoBox to create calculated fields or macros.

In our testing, creating a sales order form in Approach 96 was mostly a drag-and-drop process. Adding intelligent button macros, list boxes, and even the repeating panel required very little effort. The Fast Format icon let us copy attributes from one object to another, which saved us time when we created many similar items such as multiple menu buttons.

QUICK BUILD

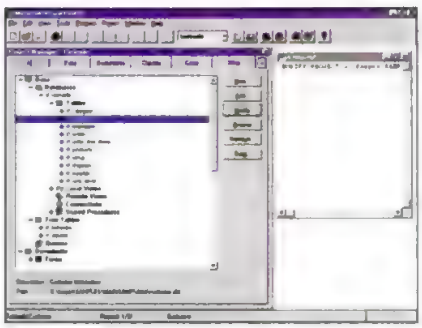
Using the built-in macro commands, we were able to create menus and buttons to automate operations without writing a line of code. More adventurous users can

When Wizards Aren't Enough

End-user database products tend to let you use only the built-in functions and formulas. In addition, end-user databases can't distribute standalone versions of the applications created in the product without resorting to add-ons.

For the most part, developer-oriented databases provide the solution to these limitations. These databases have sophisticated and complex programming languages that give the developer almost complete control over the manipulation and presentation of data. They provide a wider variety of formulas and functions, and in some cases allow users to create their own functions to perform specific tasks.

Manufacturers of high-end databases also offer a compiler—either included in the program or sold separately—that lets the developer create standalone versions of the application. These standalones are freely distributed to the end users, which reduces the need for (and cost of) multiple copies of the database package. The high-end databases also offer better support for creating Client/Server applications.



Visual FoxPro's Project Manager gives you access to the entire database application.

We've looked at three of the popular Windows-based developer databases to see how they handle the tasks we put the end-user databases through.

The DOS-based parent of **Visual dBASE**, dBASE, started the PC database revolution back in the early 1980s. Version 5.5 of Visual dBASE ($349.95), from Borland International (800-233-2444, 408-431-1000), supports both Windows 3.1 and Windows 95 (though it's still 16-bit). Of course, it supports the Xbase language (the standardized version of the dBASE programming ($349.95); Visual dBASE Client/Server package ($695), which contains the compiler as well as all the tools you need to create Client/Server applications; or the Professional Edition ($495.95), which includes both Visual dBASE and Visual dBASE Compiler.

Visual FoxPro 3.0 Professional Edition ($495), from Microsoft Corp. (800-426-9400, 206-882-8080), also supports the Xbase language. It's a full 32-bit compiler that also runs under Windows 3.1 with the win32s extensions and supports 32-bit OLE Controls as well as 32-bit ODBC drivers for Client/Server databases. Visual FoxPro comes with a number of Wizards that help perform tasks easily, including the mail-merge task.

Clarion for Windows 1.5 ($449), from TopSpeed Corp. (800-354-5444, 954-785-4555), takes a different approach, easier than that found in the other two databases: It starts with a data dictionary and uses the data definition process to build the application. Its native Clarion language is a unique combination of COBOL, ADA, and BASIC-like features. Both 16- and 32-bit developer codes ship in the same package, and it also compiles 16- or 32-

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Georgia
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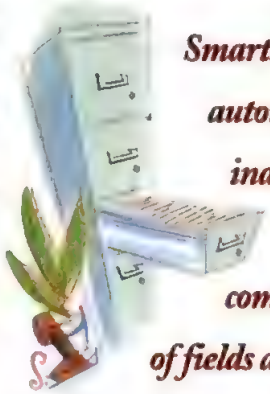
try out LotusScript, Lotus Corp.'s powerful Visual Basic–like language.

To get new users off the ground, Approach 96 comes with more than 50 sample SmartMaster applications and templates as well as a handy set of Assistants to help you through most database tasks. The sample applications range from a typical sales order system to a World Wide Web site tracking system called surfnet. You can use surfnet to launch your own Web browser or Approach 96's built-in OCX-based browser to connect to one of the 500 sample Web sites.

Though it supports ODBC, Approach's unique PowerKeys have the versatility to read almost any native database format, from dBASE to SQL Server, without any conversion or attaching. This allows you to use Approach 96 as a common front end for many disparate data formats.



SmartIndexing automatically indexes each field or combination of fields as needed.

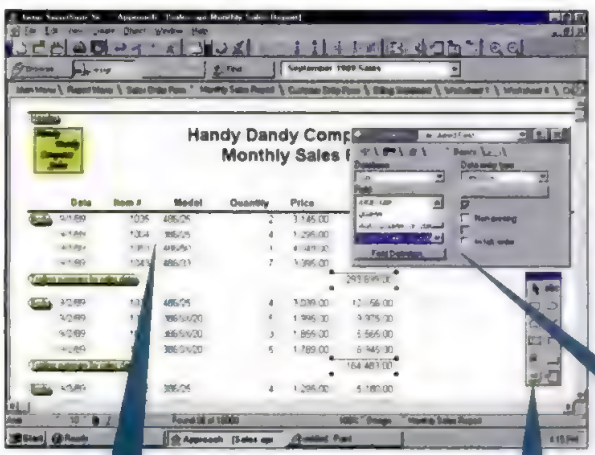
Approach 96 doesn't use key fields in the conventional sense. Instead, it uses SmartIndexing, which automatically indexes each field or combination of fields as needed. This lets you search on any fields in any database and makes the task of maintaining indexes completely transparent to the user. Throughout our testing, we saw no noticeable degradation in performance caused by this feature.

QUESTIONS AND ANSWERS

In Approach 96, you can run queries on any field or set of fields simply by entering a query by form mode or by using the powerful Find Assistant. The Assistant walks you through basic or complex queries and sorts, and it lets you save and reuse them as needed. SmartIndexing makes queries even easier: Not only can you query from the worksheet view, but you also have some true worksheet features such as performing columnar sorts and adding formula columns. You can even create dynamic crosstabs by dragging a column to the left margin, similar to Excel's PivotTable feature.

This latest version improves upon Approach's reporting, which was already fairly powerful. The enhanced PowerClick reporting feature lets you see the actual data, groupings, and totals while you're designing a report; this eliminates any guesswork about the appearance of the final output. Again the Assistants guide you through the process of creating various report types, charts, mailing labels, and envelopes.

In our testing, we used Approach 96's new Open SQL Assistant to walk us through connecting to a SQL Server, choosing a database, and querying with a SQL SELECT statement. We could see and edit the SELECT before we submitted it to the server. In addition, we seamlessly opened and worked with Lotus Notes data files, something no other database in this review could master. For complete Notes connectivity, you



The InfoBox is used for changing an object properties on forms and reports.

Lotus Approach 96 Edition's PowerClick Reporting lets you see the actual data while in design mode.

The Tool Palette lets you quickly choose between various design tools while designing forms.

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SUITABILITY TO TASK

Lotus Approach 96 Edition for Windows 95

	Power	Ease
General database	Excellent	Excellent
Forms	Excellent	Excellent
Query and analysis	Excellent	Excellent
Reporting	Excellent	Excellent
Rapid application development	Good	Excellent
Connectivity	Excellent	Excellent

can trigger replication with a Notes Server using Approach's standard macro commands.

A great combination of simplicity and power, Approach 96 should prove ideal for users needing a common front end for different data formats. It's also a perfect match for Lotus Notes shops that seek the ability to access and report on Notes data without developing in Notes or exporting to other formats.—*Greg Alwang*

Lotus Approach 96 Edition for Windows 95. Estimated street price: $105. Requires: 386-based PC or higher, 8MB RAM, 15MB hard disk space, Windows 95 or Windows NT 3.51. Lotus Development Corp., Cambridge, MA.; 800-426-7682, 617-577-8500; fax, 617-693-3512; http://www.lotus.com. *Circle 445 on reader service card.*

Microsoft Corp.

Microsoft Access for Windows 95

PC MAGAZINE EDITORS' CHOICE

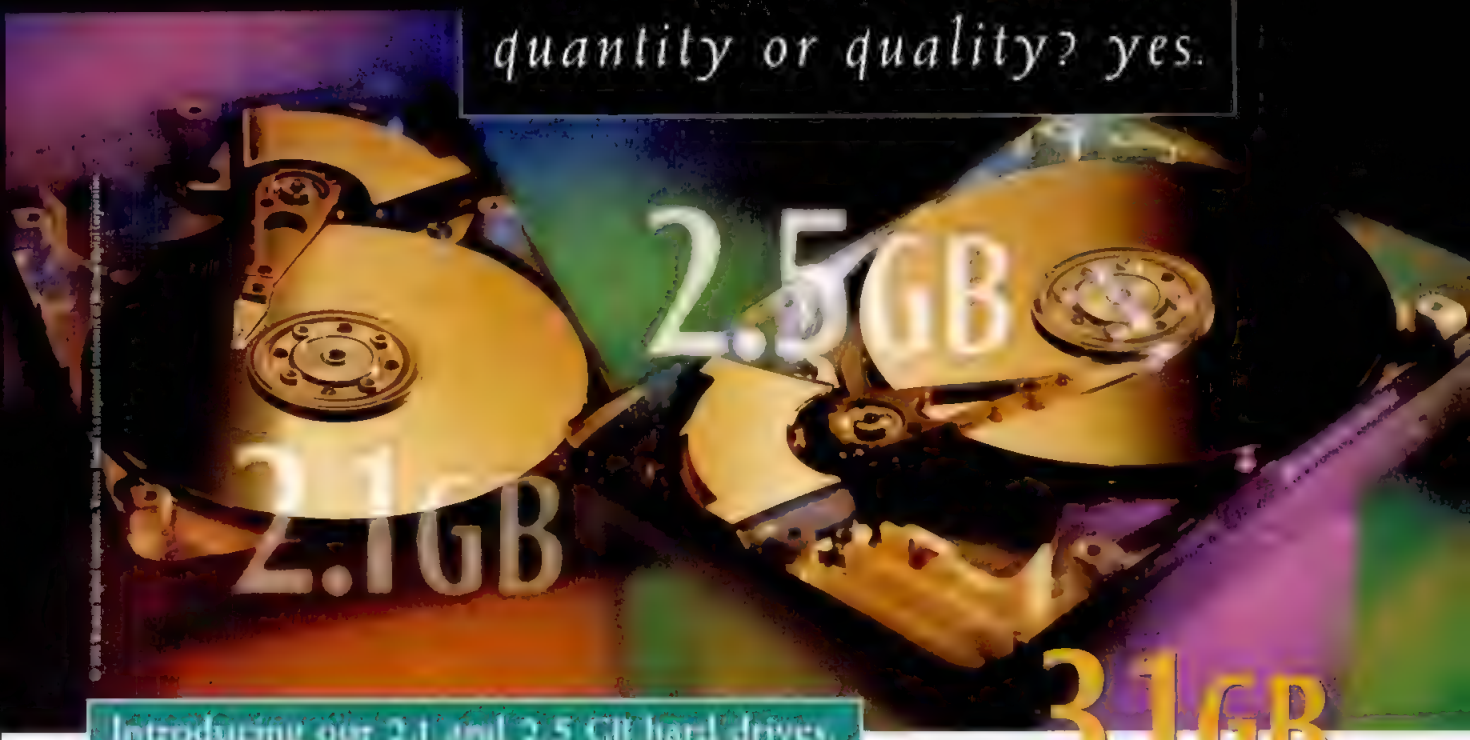
Microsoft Access has always straddled the line between end users and developers, providing enough ease of use and power to appeal to both sides. Microsoft Access for Windows 95 ($339) follows the same pattern, combining a speedy 32-bit database engine and loads of user-friendly additions to ease database creation and integration with other Microsoft Office products and Windows 95 itself.

Access expects its users to know basic database objects such as tables, queries, forms, reports, macros, and code modules. But at the same time, it offers excellent help for creating these objects and almost always provides multiple ways to accomplish a task. Unlike products such as DataEase for Windows that merge the

Drivers' Ed

CHAPTER 6:

quantity or quality? yes.



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Video - 30-60 min. compressed	270-540 MB
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SUMMARY OF FEATURES

End-User Databases

■ YES ☒ NO

Products listed in alphabetical order	Alpha Five 2	DataEase 5.11 for Windows	DBExpert 2.0	FileMaker Pro 3.0 for Windows 95	Lotus Approach 96 Edition for Windows 95 (PC MAGAZINE EDITORS' CHOICE)	Microsoft Access for Windows 95 (PC MAGAZINE EDITORS' CHOICE)	Paradox 7 for Windows 95/NT
Price	$50 (street)	$495 (list)	$149 (list)	$199 (street)	$105 (street)	$339 (street)	$299 (street)
Native operating environment	Windows 95	Windows 3.1	OS/2 2.0 or later	Windows 95/NT	Windows 95/NT	Windows 95/NT	Windows 95/NT
File Structure							
Native file format	.DBF	Proprietary	.DBF	Proprietary	.DBF	Proprietary	.DBF, proprietary
Supports multiple tables per database file	■	☒	☒	■	■	■	☒
Field Types							
Fixed/variable-length character	■ ☒	■ ☒	■ ■	☒ ■	■ ☒	■ ☒	■ ☒
Internal/external memo field	☒ ■	■ ☒	■ ■	■ ☒	☒ ■	■ ■	■ ■
Currency/Integer	☒ ■	■ ■	■ ☒	☒ ■	■ ■	■ ■	■ ■
Automatic incremental integer/Floating point	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Date/Time	■ ☒	■ ■	■ ■	■ ■	■ ■	■[2] ■[2]	■ ■
Boolean	■	■	☒	☒	■	■	■
OLE object	■	☒	☒	■	■	■	■
Data File Support (Import/export)							
Comma-delimited ASCII	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Tab-delimited ASCII	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Fixed-length ASCII	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
User-defined delimiter	■ ■	■ ■	☒ ☒	■ ■	■ ■	■ ■	■ ■
.DBF (Xbase)	■ ■	■ ☒	■ ■	■ ■	■ ■	■ ■	■ ■
.WK* (Lotus 1-2-3)	■ ■	■ ■	☒ ☒	■ ■	■ ■	■ ■	■ ■
.XLS (Microsoft Excel)	■ ■	☒ ☒	☒ ☒	☒ ☒	■ ■	■ ■	■ ■
SQL Connectivity							
Supports SQL databases natively	☒	☒	■	☒	■	☒	■
Accesses ODBC-compliant databases	☒	■	■	☒	■	■	■
Indexing							
Generates indexes automatically	■	☒	☒	■	■	■	☒
Can remove indexes	■	■	■	■	☒	■	■
Can enforce unique values	■	■	■	■	■	■	■
Supports multifield indexes	■	☒	■	■	■	■	■
Form-Building Facilities							
Form painter/wizards	■ ■	■ ☒	■ ■	■ ■	■ ■	■ ■	■ ■
Calculated fields	■	■	■	■	■	■	■
Graphs supported on forms	☒	■	■	■	■	■	■
Query and Update Facilities							
Query by form/by example	■ ■	■ ☒	■ ■	■ ☒	■ ■	■ ■	☒ ■
Query from command line	☒	■	■	☒	☒	☒	☒
Accepts SQL syntax	☒	☒	■	☒	■	■	■
Generates SQL syntax	☒	☒	■	☒	■	■	■
Cascades/Updates	■ ■	■ ■	■ ■	☒ ■	☒ ■	■ ■	■ ■
Supports referential integrity	■	■	■	■	■	■	■
Graph Functions (2-D/3-D)							
Bar chart	☒ ☒	☒ ☒	■ ☒	☒ ☒	■ ■	■ ■	■ ■
Pie chart	☒ ☒	☒ ☒	■ ☒	☒ ☒	■ ■	■ ■	■ ■
Stacked bar chart	☒ ☒	☒ ☒	☒ ☒	☒ ☒	■ ■	■ ■	■ ■
High-low-open-close chart	☒ ☒	☒ ☒	☒ ☒	☒ ☒	■ ■	☒ ☒	☒ ☒
Output Facilities							
WYSIWYG report painter	■	■	■	■	■	■	■
Supports graphs in reports	☒	☒	■	☒	■	■	■
Banded-column/form-based reports	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Cross-tab/drill-down reports	☒ ☒	☒ ■	☒ ■	☒ ☒	■ ■	■ ☒	■ ☒
Print-preview mode	■	■	■	■	■	■	■
Mail-merge facilities	■	☒	☒	■	■	■	■
Supports Avery/custom labels	■ ■	■ ■	☒ ■	■ ■	■ ■	■ ■	■ ■
Technical Support							
Context-sensitive help	■	■	■	■	■	■	■
Interactive tutorial	☒	☒	☒	■	■	■	■

1 Until June 30, 1996; $499 thereafter. 2 Microsoft Access combines time and date in a single field.

	R:BASE 5.5 for Windows	Sales for the Desktop 1.0
	$495 (list)	$149 (list)[1]
	Windows 3.1	Windows 3.1
	Proprietary	Proprietary
	■	■
	■■	■■
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	■■	■■
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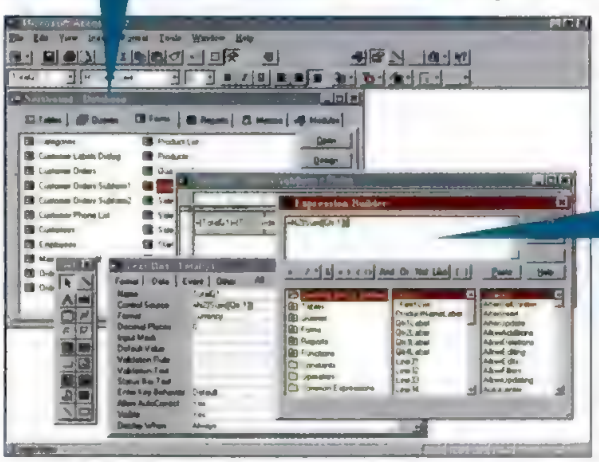
form creation process with table definition, Access makes a clear distinction: You always start with creating a database and its tables. After that, you can design queries to search for data, build forms and reports on tables or queries, and—if you want to automate your database into an application—work with macros and code modules. All this may overwhelm you at first, but Access lets you work interactively at each stage.

SEARCH, LINK, AND BUILD

The Database Explorer comprises the heart of the Access program. Microsoft enhanced the dialog box, formerly known as the Database Window, and designed it to mimic Windows 95's Explorer: It organizes objects in a clear, tabbed window that serves as the launch pad for creating, modifying, and opening your Access objects. Like other Microsoft applications, Access makes extensive use of right-click context menus and user-modifiable toolbars.

Access's standard table, Design View, lets you define fields and their properties, but you can opt to use the new Datasheet View, an Excel-like spreadsheet window that lets you easily build your own tables. You simply type data into the datasheet and Access will automatically define a table for you with the appropriate data types for each field.

Microsoft Access stores all database elements in a single .MDB file and organizes them in the tabbed Database Window.



The Expression Builder makes it easy to build formulas by pointing and clicking, as well as creating references to objects on different forms and reports

Access provides 22 sample databases and 45 sample tables. It also imports a wide array of data formats and can link seamlessly to several database, spreadsheet, and text formats through ODBC. Access can access local database formats (such as dBASE and Paradox) natively, as well as convert databases created in previous versions of Access or directly work with them in their existing formats.

SUITABILITY TO TASK

Microsoft Access for Windows 95

	Power	Ease
General database	Excellent	Good
Forms	Excellent	Good
Query and analysis	Excellent	Excellent
Reporting	Excellent	Good
Rapid application development	Excellent	Good
Connectivity	Excellent	Excellent

The Table Analyzer Wizard can scan flat-file data and normalize it into a relational model to import it most efficiently into Access. An Access database consists of a single .MDB file that contains all data, forms, reports, and other objects. Through a new replication feature, you can keep two versions of a database in sync using the Windows 95 Briefcase.

Access did well on all of our performance tests, leading the pack along with R:BASE. We found the product's two reporting facilities, Autoreport helpers and Report Wizards, very helpful. We used the separate Chart Wizard for creating analysis reports and the Label Wizard to design mailing labels. Access now also includes OfficeLinks—connections to Word and Excel—to accomplish specific tasks.

If you need to extend your database into a full-fledged application, Access provides plenty of options that help justify the costlier price (more than half the products reviewed here cost less). The product includes a macro facility with its own design interface to chain menu commands together. For more robust programming, Access—like Excel and Project—uses a form of Visual Basic for Applications as its underlying language. Access Basic is compatible with other ap-

plications, such as Excel, that use VBA.

This version is also an OLE automation controller/server, so you can drive its features from other development systems as well. Since Microsoft designed Access as a multiuser database, you can share your databases among users who have network installations. With the separate Access Developer's Toolkit product ($499, $399 upgrade), you can create royalty-free runtime versions of your databases for users who don't own Access. And at presstime, Microsoft announced that Access now supports The Internet Control Pack (downloadable from the Web at no cost), which adds Internet functionality to custom applications, and the Internet Assistant (a no-charge add-on), which automatically converts Access tables, queries, forms, and reports to HTML formats.

Access for Windows 95 is a more powerful yet easier-to-use version of an already great product. It continues to evolve in all directions at once and has developed into a product with more depth than any other end-user database. With a variety of user-assistance tools, Access gives those who are not database experts plenty of ways to accomplish tasks and, at the same time, provides a solid foundation for serious database developers.—*SWP*

Microsoft Access for Windows 95. Estimated street price: $339. Requires: 386DX-based PC or better, 12MB RAM, 14MB hard disk space, Windows 95 or Windows NT 3.51. Microsoft Corp., Redmond, WA.; 800-426-9400, 206-882-8080; fax, 206-936-7329; http://www.microsoft.com. *Circle 446 on reader service card.*

Borland International Inc.

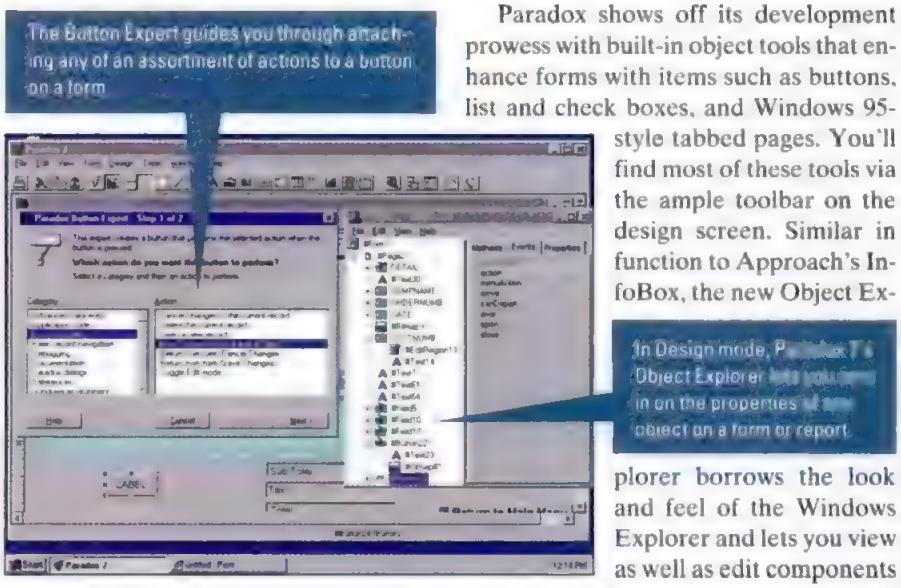
Paradox for Windows 95 and Windows NT

With the $299 Paradox 7 for Windows 95 and Windows NT, Borland International has created a 32-bit workhorse that outshines its predecessors in both strength and usability while retaining unsurpassed compatibility with its prior versions.

Paradox 7 has added many end-user touches in its revamped menu structure and new Experts that assist in the creation of items ranging from tables and reports to action buttons. When we imported data in our testing, the Experts proved worthwhile by building multitable forms, running reports, and creating charts and mailing labels. The Database Expert lets you pick from more than 30 predefined business or personal databases, and it even creates the basic forms and reports for these files.

UNDERSTANDING THE ENVIRONMENT

Keenly taking advantage of the underlying operating system, Paradox augments the Windows 95 property menu with table, form, or report commands—open, design, copy, rename, and delete—



when it points to a Paradox file in the Windows Explorer. This lets you invoke Paradox commands from the Explorer without having to first switch manually to Paradox. In addition, the new Project Viewer window lets you quickly switch to any table, form, query, report, or script in your system.

Paradox takes a slightly different approach to database access than do the other products in this review. It uses a query by example (QBE) feature that may seem less intuitive to the uninitiated user, but it's precisely this unique approach that makes Paradox's querying environment so powerful. Ironically, the list of Experts lacks a Query Expert, so end users must learn some query-by-example syntax before they can comprehend the absolute basics. Once you master the QBE syntax, you can do nearly anything. Queries in Paradox not only extract information, but they perform complex operations such as changing fields, joining and linking tables, and performing calculations as well.

You can establish relations between tables with the systemwide Data Model designer or by creating a data model for each form, report, or query. Either method presents you with a concise graphical window, in which you add tables and drag and drop links between the tables. However, the links are for lookup only. In order to enter data from multitable forms into the linked fields, you must define the field in the table structure as a Table Link field.

Paradox shows off its development prowess with built-in object tools that enhance forms with items such as buttons, list and check boxes, and Windows 95-style tabbed pages. You'll find most of these tools via the ample toolbar on the design screen. Similar in function to Approach's InfoBox, the new Object Explorer borrows the look and feel of the Windows Explorer and lets you view as well as edit components of any object on a form, including the ObjectPAL code behind those objects.

With Paradox, some knowledge of programming definitely helps. Fortunately, the ObjectPAL help system provides a generous sampling of routines that you can cut and paste to other objects. The presence of ObjectPAL and the graphical development environment gives you ultimate control over the look and feel of the system. We used the built-in constructs to quickly put together custom tabbed page menus and action buttons for choosing different operations in our sample database.

In Paradox, labels and mail-merges are simply point-and-click operations, while charting and basic reporting involve a series of basic choices. You can also create simple multitable reports with the Experts, but more complex reports entail some time spent on design and may require some ObjectPAL code. When you work in Para-

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SUITABILITY TO TASK

Paradox

	Power	Ease
General database	Excellent	Good
Forms	Good	Good
Query and analysis	Excellent	Good
Reporting	Good	Good
Rapid application development	Good	Good
Connectivity	Good	Good

dox's design mode, you don't see the actual data on the screen, as you do in Lotus Approach: You can only view an output sample when you run the actual report.

Paradox, always a network-savvy database application, offers broad connectivity with a variety of different data types. This version sports a new SQL Link module for natively connecting to SQL databases and running SQL queries.

Paradox offers a palatable mix of robust development tools and end-user assistance, but the way it handles complex tasks may intimidate first-time users. For Paradox aficionados, though, this new release—with its improved interface, compatibility with previous versions, and 32-bit capabilities—is a must-have.—*GA*

Paradox 7 for Windows 95 and Windows NT. Estimated street price: $299. Requires: 386DX-based PC or better, 8MB RAM, 13MB hard disk space, Windows 95 or Windows NT 3.51. Borland International Inc., Scotts Valley, CA.; 800-233-2444, 408-431-1000; fax, 716-873-0906; http://www.borland.com. *Circle 447 on reader service card.*

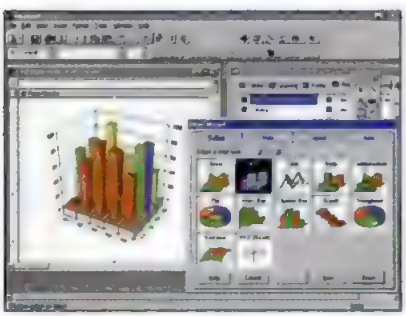
Microrim Inc.

R:BASE for Windows

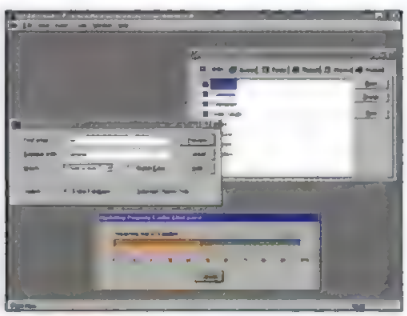
Though not traditionally known for its flash, the latest release of Microrim's R:BASE for Windows offers some appealing user interface enhancements that allow end users to take control of their data without programming. Though this version of R:BASE suits developers best, end users can still find what they need to create databases on their own. R:BASE, now a 32-bit application, runs

End-User Database Add-Ons

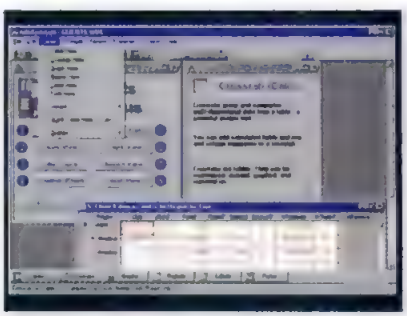
While the enhanced ease of use touted in many of today's end-user databases should make your databasing life a little easier, finding the right add-on tool can take your work to the next level. These database add-ons make program maintenance a snap and help you create that perfect chart or report.—RVD



FIRST IMPRESSION 2.0 ($249), from Visual Components Inc. (800-884-8665, 913-599-6500), creates impressive 3-D graphs, including photorealistic rendering techniques. This OCX control add-on works seamlessly from within Microsoft Access 95 or any other OCX-enabled package.

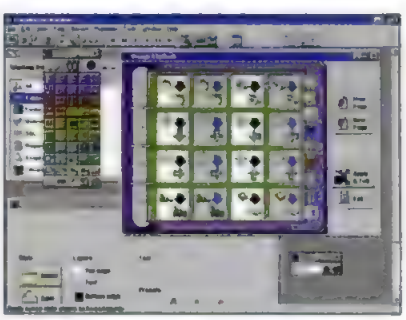


SPEED FERRET for Access 95 ($89), from Black Moshannon Systems (814-345-5657), lets you safely change tables, queries, fields, and any other objects in Access databases. It automatically manages backups of objects and tables before you make any changes to your database.



INFOASSISTANT 1.0b ($695), from Asymetrix Corp. (800-448-6543, 206-462-0501), offers a truly ecumenical approach to data analysis and decision support. Mix-and-match any ODBC/IDAPI data source, and create intuitive queries and reports (including crosstabs) using Wizard-based assistants.

PARA STAT 7.0 for Windows ($245), from FMS Inc. (703-356-4700), helps you get high-powered statistical analysis from your Paradox data. Parametric, group (such as analysis of variance), and non-parametric statistical analysis are available using a Paradox 7 Expert. Just specify the data and the type of analysis.



VISAGE 2.0 for Paradox 7 ($299), from Ensemble Corp. (800-797-9957, 214-960-2700), simplifies designing Paradox forms. This package lets you easily design forms using a toolbox that controls placement and properties of each control. Also included are custom controls for designing more elaborate Paradox interfaces.

TIMEFRAME PRO FOR WINDOWS ($49), from Apex Computing Technologies (919-387-4744), is one example of the thriving market of database solutions tailored to specific real-world settings that FileMaker Pro has inspired. It offers a personal information manager, with contacts, budgeting, planning, and a calendar.

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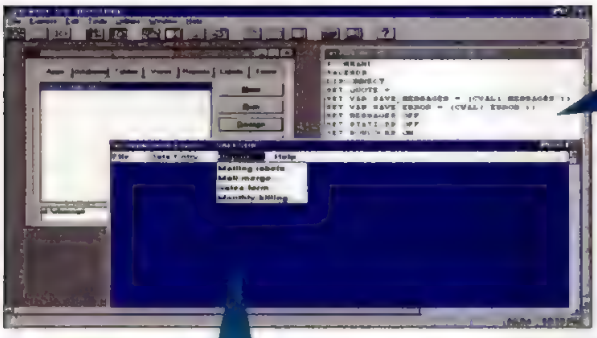


You can also automatically generate an R:BASE script, which could be several hundred lines of code.

R:BASE for Windows' Application Express lets you design menus visually.

under Windows 3.*x* using Win32s.

The command center for R:BASE 5.5 for Windows is its Object Manager, which features a tabbed dialog interface that gives you quick access to your tables, forms, and reports. Microrim hasn't adapted R:BASE's interface specifically to Windows 95, though you can use the right mouse button to access menus throughout the product.

BASE OF OPERATIONS

The Database Designer lets you define a table easily with a spreadsheet for defining columns and keys. R:BASE has a proprietary native database format and also supports a wide variety of data types with full coverage of native SQL types. You can rest assured that your data requirements will probably not outgrow the capabilities of R:BASE. Variable-length character fields, for instance, can fill up to 256MB. In addition, R:BASE supports counter data types and binary large object (BLOB) fields, and you can also set rules for fields to ensure data integrity like setting ranges for fields.

Once you define your tables, you can import data from a wide variety of source files, including Microsoft Excel 4.0 and 5.0, dBASE IV, and text files. Based on our performance testing, importing worked smoothly and quickly.

SUITABILITY TO TASK

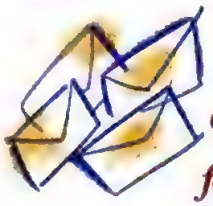
R:BASE for Windows

	Power	Ease
General database	Excellent	Good
Forms	Good	Good
Query and analysis	Excellent	Good
Reporting	Good	Good
Rapid application development	Excellent	Good
Connectivity	Excellent	Good

In R:BASE, you design data entry forms with the Form Designer tool. Using the Quick Form option, you can automatically generate a default form with selected fields using a table or existing query for multiple tables joined together on one or more fields. The interface functions smoothly. You can set properties for each field, including formatting for phone numbers or ZIP codes.

You embed detail records in R:BASE forms with tiers of records, which designate rows of records that are repeated within a screen area. Once you set a tier, you can edit it by clicking on the right mouse button. Nonprogrammers, though, will have better results on simpler forms, which R:BASE can generate automatically.

With R:BASE, you can query any ODBC-compliant database as well as native tables with its Query By Example tool. You select tables and fields, and R:BASE generates a default query using a Structured Query Language (SQL) statement. The results of queries are saved as views that you can search and sort. Though based on SQL, R:BASE does its best to automate query creation for you. For example, the "Where Builder" helps you filter records, and you can create SQL sort clauses automatically. Despite a few quirks, it's a useful tool for accessing your data.



Once you open a view for browsing groups of records, R:BASE browses, edits, and analyzes data quite well.

Once you open a view for browsing groups of records, R:BASE browses, edits, and analyzes data quite well. A number of handy features here help you understand your data. The Compute option lets you view basic statistics for a column of numerical data including minimum and maximum values, averages, and standard deviation. You can create crosstab views easily, add numerical data with the tally option, and group records by the values in a desired column.

THE REPORTER

When it comes to reporting, R:BASE provides two separate tools: the Label Designer and the Report Designer. Though the Label Designer doesn't support standard Avery label numbers, it includes many common label sizes and can create custom labels. The Report Designer, though competent for basic reports, lacks charting and graphing capabilities. In order to create crosstabs and other sophisticated reports, you have to build R:BASE macro variables, a daunting task for end users.

The Application Express tool, one of R:BASE's most useful features for nonprogrammers, lets you design a menu visually—just click and type items—and then add processing to each menu item, such as opening a form or printing a report. Once you're satisfied with your choices, the Application Express tool will generate the R:BASE script code that brings your design to life.

The Application Express tool puts the power of this scripting language into the hands of new users. With it, you can create real database applications complete with multiuser support. (The $695 LAN Pack allows five additional users to share your R:BASE database on the network.)

On the whole, R:BASE 5.5 for Windows proved a solid package, though with fewer ease-of-use features than some of the other products reviewed here. But with a few hours of work, even nonprogrammers can implement this industrial-strength multiuser database. —*RVD*

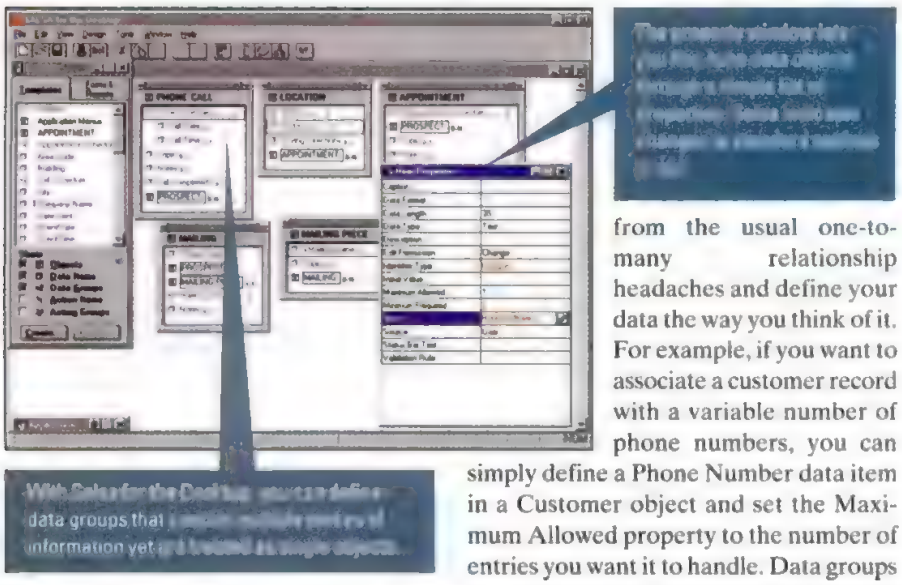
R:BASE 5.5 for Windows. List price: $495. Requires: 386-based PC or better, 8MB RAM, 15MB hard disk space, Windows 3.*x* or later. Microrim Inc., Bellevue, WA; 800-628-6990, 206-649-9500; fax, 206-649-2785; http://www.microrim.com. *Circle 448 on reader service card.*

Wall Data Inc.

Salsa for the Desktop

Wall Data's Salsa for the Desktop 1.0 ambitiously attempts to remove most of the complexity from your database and create an entire custom application for you automatically. While this first release takes an innovative approach and sells for an appealing $149 through this June ($499 thereafter), it lacks the performance necessary for effective application.

Salsa is based on the semantic object model, a database implementation technique that enables users to design data models according to the way they normally think of information, rather than traditional table/field designs. Then, once you've established relationships between the various objects, Salsa will read the data model to create a collection of forms, reports, and query windows for each of the data objects you've defined.



It also builds a standard application window and custom menus to provide a fully functional custom application, unlike any other database package reviewed here. Salsa hides complexities such as relationship types and table normalization during this process.

Salsa includes a small set of Starter Kits you can use as starting points for your own application. The Starter Kit you cation Starter Kits and four sets of templates. Once you've chosen a Starter Kit to work with, you enter the program's workspace window where you work on your data model. Wall Data sells additional Starter Kits separately for $49 each, but we'd like to see more in the base product.

We found some interesting innovations in Salsa's workspace. The program sheds the traditional table-and-field approach and instead offers a more holistic view of your data and the flexibility to design it the way you work. You're free to create "objects" by dragging object templates into the workspace or simply drawing an object with the mouse. If you want, you can define objects as traditional tables. You can also place data items (Salsa's term for fields) and data groups in your objects via drag and drop.

Data groups and multivalued fields provide powerful functionality in an understated and smooth fashion. With multivalued fields, you can break free from the usual one-to-many relationship headaches and define your data the way you think of it. For example, if you want to associate a customer record with a variable number of phone numbers, you can simply define a Phone Number data item in a Customer object and set the Maximum Allowed property to the number of entries you want it to handle. Data groups let you associate multiple data items and treat them as a single entity.

DIPPING IN

Salsa also makes relationships easier to define. To relate data objects, you simply drag the name of an object into the container object of another; you don't have to pick the particular items to relate as you do in other products. Salsa reads your

SUITABILITY TO TASK

Salsa for the Desktop

	Power	Ease
General database	Good	Good
Forms	Fair	Good
Query and analysis	Fair	Good
Reporting	Fair	Good
Rapid application development	Good	Good
Connectivity	Fair	Good

groups, action items and action groups help you fine-tune your application even more. Each Catalog includes a set of action items, common operations you may wish to incorporate into your application. The list includes tasks such as Clear Form, Delete Record, Help Contents, and Print Setup. Salsa automatically creates forms and reports based upon your object model. If the object model contains an action item, Salsa will create a button for that item when it generates the form. You can write your own action items using the product's Salsa Basic language, a dialect very similar to Microsoft's Visual Basic for Applications.

While Salsa built our test application very quickly, we found a few flaws. The program uses a proprietary data format and requires that all existing data be imported. Given this, we were surprised to discover the product's disjointed, lengthy import process, which Wall Data plans to improve in Salsa's next release. We also found Salsa particularly unsuitable for large data sets and sometimes slow in building applications: Our performance tests proved Salsa slowest among the products we tested, and it took almost half an hour on an 8MB 486DX2/66 to rebuild an application. In addition, Salsa cannot display more than 16,000 records at a time in a query result, a hindrance that Wall Data also plans to address for Salsa's next release.

Salsa is a step in a bold new direction and definitely a product to watch. But Wall Data's first iteration comes up a bit short, mainly because of its incredibly slow performance.—*SWP* □

Salsa for the Desktop 1.0. List price: $149 through June 30, 1996; $499 thereafter. Requires: 386-based PC or better, 8MB RAM, 35MB hard disk space, Windows

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SEYMOUR EDITORS' HOT PICKS

THE NOS EVOLVED

Network operating systems have come a long way from being simple file and print workhorses. But can one NOS fulfill all your essential network needs?

In this roundup, we evaluate the ability of four network operating systems (NOSs) to serve as your total network operating environment. We're looking for an environment that sustains and supports applications while making the connections between resources invisible. We're also looking for such essential network applications as messaging, management, and Internet access offered either as part of the NOS or as a separate application from the NOS vendor.

We had complete network environments back when we depended solely on Burroughs, IBM, or Unisys for our computing needs. The mainframe environment gave us electrical and operational connections in common, shared applications, and networkwide tools—if we stayed with one vendor. We gladly traded those confined environments for the freedom we gained when names like Novell and Banyan entered our vocabulary. More recently, IBM and Microsoft have become major network operating-system players. These are the four vendors in our current roundup.

The network environment has returned, but now, instead being one color and constraining, it's a rainbow of light and openness. It's possible, and often necessary, to blend NOSs from a couple of vendors, taking advantage of the strengths each has to offer to make things comfortable and productive in your networking biosphere.

The NOS market started an evolutionary sprint toward being an integrated environment when Artisoft and Performance Technology introduced client software that would work with many

By Frank J. Derfler, Jr.

ILLUSTRATION BY JOEL NAKAMURA

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types of servers. Overnight, the species of special client-side networking software maintained by Banyan, Novell, and others was doomed. Microsoft followed, and now Windows 95 is the universal client, able to link to half a dozen different server operating systems simultaneously while the user is none the wiser. IBM put the same universal client capabilities into OS/2 Warp Connect.

Because of this evolutionary step and such other events as Microsoft's adoption of Novell's network transport protocol, IPX/SPX, we have software flexibility on our servers and options in our extensions to the network.

And indeed, most networks today run a blend of NOSs. One—often NetWare—may specialize in file and print functions and, in some cases, directory services. Another—often IBM's OS/2 or Microsoft Windows NT—provides services for such networked applications as messaging and databases.

In the last few years, however, vendors have begun rounding out their NOS offerings. They've added such functions as remote access, Web servers, network and storage management, and messaging—functions formerly found only in separate applications. Powerful directory or naming services have become essential to the modern NOS for managing large enterprises with multiple servers and locations.

And NOS vendors, notably Microsoft, are offering packages of separate applications to compete with third-party vendors. Microsoft offers the BackOffice suite, consisting of Microsoft Exchange 4.0, Microsoft SNA Server 2.11, Microsoft SQL Server 6.0, and Microsoft Systems Management Server 1.1. But Microsoft isn't alone. Novell offers GroupWise and ManageWise for NetWare, and IBM offers Lotus Notes and DB2 for OS/2. Later this year, IBM will offer a suite of products similar in function to that of BackOffice.

REVIEW CRITERIA

In this roundup, we set out to determine whether an entire operating environment could be supplied by a single NOS vendor. We thoroughly tested 32-bit NOSs with a strong file and print base, since that is the meat of most networks today. Given the size and diversity of many of today's network environments, we required that the NOS offer some kind of directory or naming services and that it support DOS, Macintosh, OS/2, Windows 3.*x*, Windows 95, and Unix clients.

We also asked each NOS vendor to supply key products that could satisfy the messaging, database, remote-access, and Internet-access needs of the average network environment. PC Labs then tested each NOS and its applications to determine the power and scope of each as a total network operating environment (see "How We Tested").

For those networks in which powerful application services are the primary need, with file and print services a secondary requirement, we also look at three Unix-based NOSs for Intel's *x*86 systems—Solaris Application Server, SCO OpenServer, and SCO UnixWare—in a sidebar. In another sidebar, we look at Artisoft's LANtastic Power Suite, a suite

HIGHLIGHTS

Network Operating Environments

The days of the simple file and print network operating system (NOS) are long gone. Today's networks require a whole spectrum of services, including processing power to run database and messaging applications, directory services for managing multilocation, multiserver networks, multiple protocols for multi-NOS environments, Internet connectivity, remote access, and groupware. Can one NOS vendor provide everything the total network environment needs? The answer is no. But NOS vendors have been working hard toward that goal, providing new services either within the NOS or in NOS-related products.

Most networks today run a blend of network operating systems, with one—often NetWare—specializing in file and print functions, and, in some cases, directory services. As in the past, users traditionally have to resort to another NOS platform to complete their network operating environments. You'll find them using OS/2, Windows NT Server, or a Unix variant to provide process-intensive application services.

File and print services are the environmental bedrock for most networks. Whereas NetWare used to be *the* platform for file and print, the NOSs we review essentially provide the same level of file and print services, with some minor differences.

Directory and naming services are of crucial importance in widespread, multiserver organizations. Besides providing enterprise-wide access to network resources, a global directory service—such as NetWare Directory Services (NDS) or Banyan's StreetTalk—makes managing the enterprise considerably easier. Microsoft Windows NT and OS/2 Warp Server Advanced provide similar services in a domain-based architecture, which can be unwieldy when used in a large enterprise with multiple locations. None of the NOS vendors have succeeded in integrating their directory services with other NOS applications.

Microsoft's BackOffice suite comes closest to offering all the functions necessary for a total networking environment. Keep an eye on IBM's OS/2 Warp Server Advanced, which IBM claims will have directory services, multiprocessor support, and a network application suite later this year.

Powerful application services are the primary need for some networks, with file and print a secondary requirement. In contrast to the file-and-print workhorses in our main roundup, Unix-based operating systems—such as Solaris Application Server, SCO OpenServer, and SCO UnixWare—focus on delivering scalable, application-driven performance. They tend, however, not to include more general-purpose messaging or remote-access products.

of networking applications for small businesses and organizations. Finally, in a third sidebar we evaluate using Internet technologies to provide messaging and information services on your network.

What did we find to be the best choice among the burly 32-bit network operating systems? Now more than ever, the answer is some of the above or all of the above. While we found that Microsoft comes closest to offering a complete network operating environment, no single vendor completely fills the bill.

In most cases, you will end up running some combination of IBM's OS/2 Warp Server Advanced, Microsoft's Windows NT 3.51 Server, Novell's NetWare 4.1, and Banyan VINES 6.0 on the same network to get the desired blend of features, cost, and performance. We recommend a blend of NetWare and Windows NT for performance and flexibility, but OS/2 and Unix variants such as SCO's UnixWare can also play a role in your environment.

A blend of NetWare 4.1 and Microsoft Windows NT Server 3.51

We tested the offerings of four NOS vendors and found that no single vendor fulfills all the needs of a complete network operating environment.

Today's networks have a whole spectrum of requirements, from powerful file and print sharing to application services, Internet integration, enterprise naming services, remote access, and group collaboration. If you want to get the best of all of these functions, the answer, at least for the time being, is to mix and match NOSs.

Microsoft Windows NT Server 3.51 gets an honorable mention for its combination of good file and print capabilities, excellent application services, and the optional messaging, database, mainframe connectivity, and management applications contained in the Microsoft BackOffice applications suite. The products that make up Microsoft BackOffice integrate well with one another and with Windows NT Server to provide just about all the functions a network operating environment needs.

Unfortunately, Windows NT Server lacks one crucial requirement for a complete networking environment: powerful naming services. Windows NT Server's naming services are based on domains, each of which can contain only one defined organization. It is possible to link domains so that users in one domain can easily access the files and services of another. The process of setting up and managing these links is, however, considerably more complex and cumbersome than working with NetWare 4.1's NetWare Directory Services (NDS) or Banyan's StreetTalk.

Another honorable mention goes to NetWare 4.1, from Novell. NetWare provides its own almost winning combination of top-notch file and print capabilities and powerful directory and naming services. But for running network database and messaging applications, NetWare falls short of Windows NT Server, because NetWare cannot run on any processors other than Intel's. To get multiprocessing capabilities you have to purchase a different product—NetWare SMP 4.1. And both of these Novell products still run applications in NetWare Loadable Modules (NLMs), which are potentially unstable and difficult to program.

Keep an eye on IBM's OS/2 Warp Server Advanced, which is full of valuable features and will offer directory services and multiprocessing later this year. Banyan Systems' VINES 6.0 is valuable primarily for the powerful, multiplatform directory services of StreetTalk.

THE PARTS OF AN NETWORK ENVIRONMENT

What makes up an environment and how do you evaluate it? There are several layers:

• *File and print.* The environmental bedrock is still sharing files and printers. The performance and capability of file and print sharing are fundamental.

• *Application services.* The ability to run messaging, database, and other server-based applications efficiently in a client/server network is an essential requirement of most modern networks. Multiprocessor support is an essential ingredient here, as are fault tolerance, high-quality development tools, and application support from third-party vendors.

• *Hardware integration.* If the system doesn't work on the hardware you have, want, or trust, then the air is too rarefied for growth. Both the type of processor and the ability to use more than one processor are big factors here as well.

• *Networking infrastructure.* This includes the ease of use of the network transport protocols and how well the server software handles multiple LAN adapters and internal routing. The rich fruits of the network environment, ranging from client/server operations to Internet access, grow from this base.

• *Internet integration.* Internet access from the network is becoming a necessity in many organizations. The ability to run TCP/IP and the Dynamic Host Configuration Protocol (DHCP) for keeping track of TCP/IP addresses on the network is key. Web server software is also important.

• *Remote access.* Business trips and telecommuting require that networks offer a solid remote-access solution.

• *Messaging and groupware.* Many organizations today rely on powerful groupware solutions for internal communications. In addition to e-mail, group discussion and work-flow features are essential in many cases, as is support for existing messaging APIs such as MAPI.

• *Directory and naming services.* In large multilocation, multiserver organizations, directory and naming services provide enterprise-wide access to network resources, including servers, files, applications, mail addresses, and printers.

NETWORK OPERATING ENVIRONMENTS

How to Read the Suitability to Task Boxes

File and print services remain the sine qua non for most networks. The main chore of NOSs in workgroup-oriented networks is to allow local users access to files and printers. We award high marks for systems that set up quickly and easily, taking into account tools for log-on and security. We rate each product's file-system options, disk-partitioning tools, and directory and file structures. We also evaluate print queue and notification options for server-based, remote, and on-the-wire printer connections. We evaluate client integration by attaching desktop systems running multiple operating systems.

Directory and domain services are essential when networks extend beyond locally connected users. In evaluating these services we take into account organizational structure, naming conventions, the number of definable objects and attributes, the method of synchronization across servers, and the ability to discover new users, devices, and applications automatically. We also rate security, scalability, and ease of management. In determining user benefits, we look for location-independent log-on to the network and evaluate the tools provided for navigating system resources. Better services work with multiple NOSs, integrate with applications, and store data logically to reduce administration requirements.

In grading **environment tools and applications,** we look for essential network functions provided by the NOS and other products offered by the NOS vendor. We give top marks for products that provide groupware, remote access, and Internet services integrated with the underlying NOS and directory service. Stable and scalable platforms that offer application services and friendly development environments receive high marks. We also consider protocol support and the tools provided for connecting with other public and private networks.

SUITABILITY TO TASK

Product name

	Power	Ease
File and print services	Good	Excellent
Directory and domain services	Fair	Fair
Environmental tools and applications	Good	Good

BEDROCK

All of the products we review here provide adequate client file and print services. Under normal conditions, users can't see a difference in the time it takes to pull a file from one type of server or another.

NetWare offers more features and flexibility in its file and printing services than the other NOSs we examined. But its efficient file-server software has been a comfortable trap for Novell. NetWare's developers didn't worry about writing code for multiple processors or for RISC processors, because NetWare works so well on one Intel processor.

But database and applications servers—critical parts of a modern networking environment—crave multiple processors and the special talents of RISC processors. Novell's developers have only recently woken up to this fact, offering a multiprocessing version of NetWare called NetWare SMP. Unfortunately, NetWare SMP still houses applications in NetWare Loadable Modules (NLMs), which can be unstable and are difficult to program. Recently, Novell announced its partnership with Sun Microsystems to integrate Sun's Java with NetWare as its application framework.

When it comes to application services, Windows NT Server comes out ahead with its support for multiple and non-Intel processors, abundant APIs, and applications from third-party application vendors. Although OS/2 is also a friendly environment for application servers and has extensive third-party support, it doesn't have the hardware reach of Windows NT.

LANS TO WANS

New needs evolve when LANs connect across a wide-area network. Even finding resources and people across interconnected LANs can be a problem. VINES and NetWare each have their own powerful enterprise-wide naming services. Whether you plug your laptop into a LAN connection in the corporate skyscraper, in a small field sales office, or in an overseas manufacturing plant, the naming service lets you use the same log-on and gives you access to your standard servers and network tools.

OS/2, VINES, Windows NT, and some Unix systems use a different naming and security setup called *domains.* Like the naming services offered by Banyan and Novell, the domain system will give travelers easy access to the network, but only after an exchange of verification information takes place between domain servers that "trust" each other.

OS/2, VINES, and Windows NT servers are also more at home with the Internet Protocol (IP) than NetWare is. IP carries the favorite sorting tags of the powerful internetworking routers, while NetWare IPX doesn't convey all of the routing information of IP. The situation has improved, however, now that NetWare provides NetWare/IP.

STATIC OR GROWING?

If your organization is using a local network only to store word processing and spreadsheet files and to print, then any of these operating systems can be your environment by itself. But if your system includes a number of geographical locations and you pass information and requests for functions between sophisticated applications, then you need a rich multi-NOS environment to support it.

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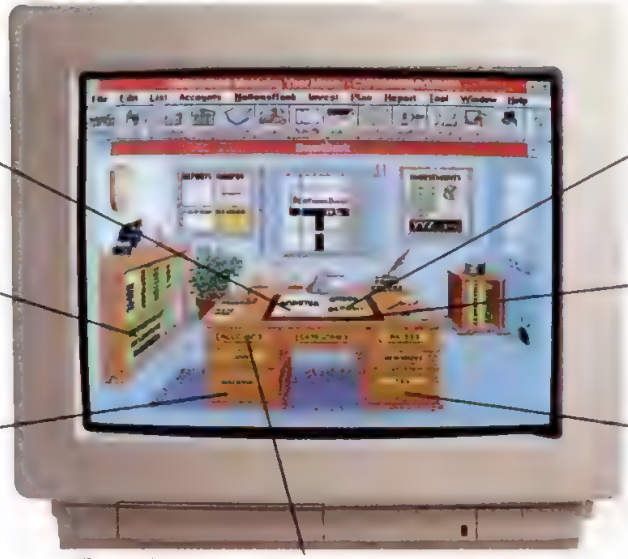

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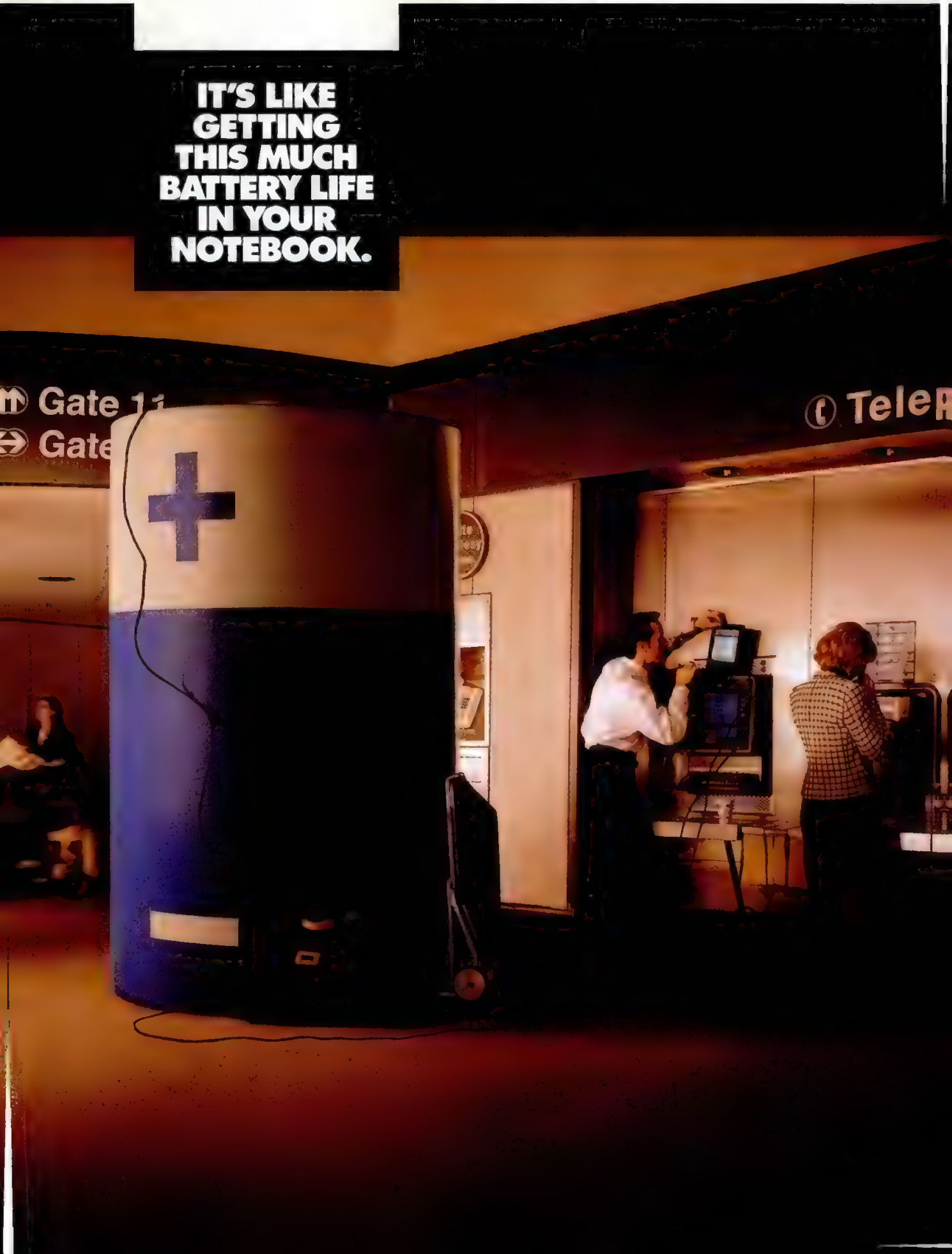
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SYSTEM NOT PICTURED

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SYSTEM NOT PICTURED

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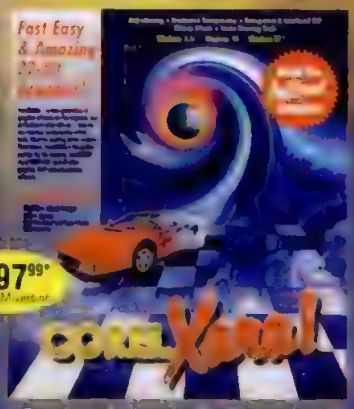

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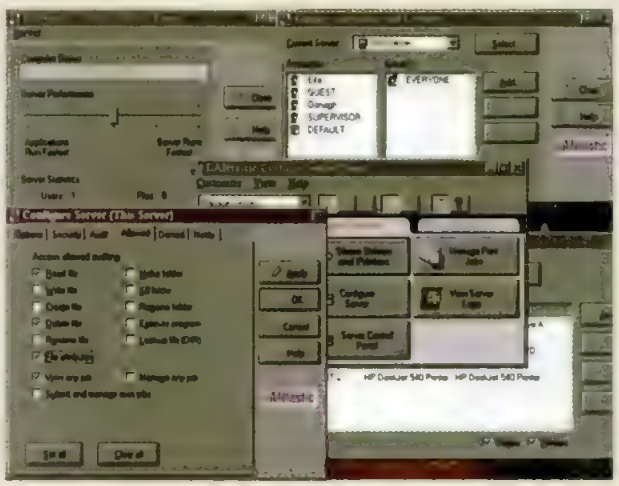
LANtastic: Network Environment on a Budget

By Padraic Boyle

If you're looking for an inexpensive way to create a small network environment, LANtastic Power Suite ($199 for one user, $1,499 for ten users) may provide all the file, print, and communications resources you need. It combines LANtastic 6.1 with Lotus cc:Mail and Lotus Organizer, Cheyenne's BitShare modem-sharing and BitWare communications/fax packages, and NetCom's NetCruiser Internet access software. The only component not available for LANtastic is a database package. We didn't include LANtastic in our main roundup, because it lacks directory services, among other advanced network services.

The heart of the Power Suite, LANtastic 6.1, is a peer-to-peer network solution that lets networked clients share one another's hard disks, printers, and CD-ROM drives. File and printer sharing are the most common uses for LANtastic and are the product's most mature feature. You can install LANtastic on just about any DOS or Windows PC to turn it into a peer-to-peer server; the minimum requirements are DOS 5.0, 5MB of hard disk space, and 4MB of RAM. The integrated installation program for LANtastic Power Suite lets you choose which components to install.

Artisoft now ships a Windows 95 version of LANtastic. Although Windows 95 and Windows for Workgroups include some peer-to-peer functionality, neither OS offers the long list of features that Artisoft packs into LANtastic. Furthermore, LANtastic allows you to network DOS and Windows 3.1 users.



LANtastic offers more extensive options than Windows 95's built-in peer-to-peer functionality, including support for multiple-client OSs.

In addition to communicating with other LANtastic users, LANtastic 6.1 can share files and printers with other NOSs including LAN Manager, IBM's LAN Server, NetWare, Windows for Workgroups, and Windows NT Server and Workstation.

LANtastic offers many of the same security features as the big NOSs but without all of the hassles. User accounts are created and managed via the Network Manager utility. An access control list (ACL) is used to allow or deny users access to data or devices on one or more servers. The ACL can be configured for individual servers or for all LANtastic servers.

If your needs grow beyond peer-to-peer file sharing, Artisoft also offers a LANtastic Dedicated Server. Architecturally based on a NetWare 3.*x* server, it can run most NLMs for NetWare 3.*x*. It costs $899 (for existing LANtastic sites).

SUITE DEAL

The products included with LANtastic Power Suite provide a rich array of services for the small office. Lotus cc:Mail is one of the most popular e-mail systems on the market. When you install cc:Mail, you must designate at least one PC on the network as a Post Office. Windows and DOS users can coexist in the same e-mail environment with cc:Mail 2.1 for Windows and cc:Mail 4.02 for DOS. Additionally, Lotus offers other products that provide gateway communications between cc:Mail and other e-mail systems, including SMTP and UUCP gateways for Internet mail connectivity.

To complement cc:Mail, Artisoft bundles Lotus Organizer 2.01—Lotus's personal information manager (PIM), calendar, and scheduler. Organizer can be used as a standalone or, for full use of the product, in the LANtastic network. In a networked configuration, Organizer offers the ability to view the schedules of others.

Another useful feature of Power Suite is Cheyenne Software's BitShare 4.0 for Windows and DOS, which lets users dial out of the network from shared modems. Cheyenne's BitWare 3.2 for Windows and 4.1 for DOS offer both data communications and fax send-and-receive packages allowing users to take advantage of online and fax services.

Rounding out Power Suite is NetCom's NetCruiser 1.6. NetCruiser offers Windows users all the tools needed to surf the World Wide Web, copy files using FTP, and telnet into remote hosts over the Internet. Users must purchase an account from NetCom—or another Internet service provider (ISP)—before they can access the Internet. And they can use BitShare's modem-sharing feature to dial out, with a single Internet access account.

Artisoft's LANtastic Power Suite covers practically all the software needs for today's small business. Power Suite even offers a file synchronization utility, PowerSync, from Linkpro, making synchronizing files between two networked computers an automatic task.

LANtastic Power Suite. List price: Single user, $199; 10 users, $1,499. Artisoft Inc., Tucson, AZ; 800-233-5564, 520-670-7100; fax, 520-670-7101; http:// www.artisoft.com. *Circle 468 on reader service card.*

Microsoft Corp.

Microsoft Windows NT Server 3.51

Of the products we tested, Windows NT Server, when combined with the Microsoft BackOffice application suite, comes closest to having all the features and applications necessary for a complete network operating environment. Windows NT Server is a solid platform for file, print, and application services. And Microsoft BackOffice provides the most comprehensive and well-integrated suite of server applications offered by any of the vendors in this review. Unfortunately, one conspicuous omission—a true global directory service—is a stumbling block for large organizations that need an enterprise-wide naming service.

Built on Microsoft's 32-bit, preemptive architecture, Windows NT Server comes with good file and print services and a bevy of server administrative and management tools. With its Window's graphical interface Windows NT Server is also the easiest product in this review to use. We tested the Windows NT Server with Service Pack 4, the most recent set of bug fixes and code enhancements.

Windows NT Server's strengths as an application server are well known. The operating system's abundant set of APIs provides direct access to basic services such as the file system, memory management, and symmetric multiprocessing (SMP) for up to 32 processors, easing the application development process. And, unlike NetWare 4.1 and OS/2 Warp Server, Windows NT Server supports both single and multiprocessing in one package. Windows NT Server is also available to run on Alpha, MIPS, and other systems based on non-Intel processors. (For more information, see "Serving Up Apps," October 24, 1995.)

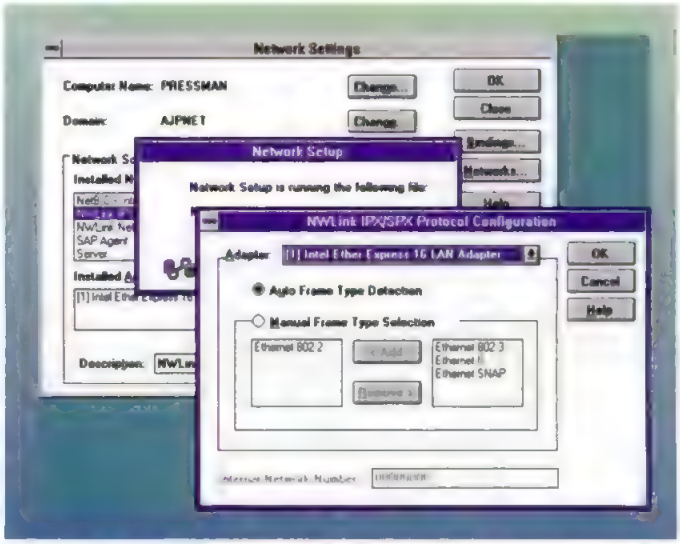
Most of Windows NT Server's tools offer the usual Windows-interface buttons and pull-down menus. But the slick veneer of Windows doesn't completely eliminate the need for an occasional look into a help file. While the Windows interface simplifies installation, some of the management tools need a little refining. For example, Windows NT Server uses separate tools for print services and user management. Combining these functions into one utility would greatly simplify administration. Version 4.0 of Windows NT Server, due to ship this summer, promises to improve the interface by replacing the existing GUI with that of Windows 95.

Networked printing under Windows NT Server is about as straightforward as it can get. Extending the Windows Print Manager metaphor, print sharing is a matter of connecting a printer directly to a server and using the Shares option to give users printer access. Windows NT Server can also run popular print servers such as HP's JetDirect or Intel's NetPort series. Consistent with Windows NT Server's theme of network independence, print servers can communicate with Windows NT servers over a variety of network protocols, including DLC, IP, and IPX.

SUITABILITY TO TASK

Microsoft Windows NT Server 3.51

	Power	Ease
File and print services	Good	Excellent
Directory and domain services	Fair	Fair
Environmental tools and applications	Good	Good



Microsoft Windows NT Server makes it simple to set up even complex configurations of multiple protocol and frame types.

NAME THAT DOMAIN

Windows NT Server uses a domain-based directory architecture. If its domains and access rights are properly set up, users can access any Windows NT server or resource from a single log-on. A master directory of domain information is stored on a Windows NT server called the Primary Domain Controller. Directory changes, such as the addition of a user, are immediately added to the Primary Domain Controller's directory. Each Windows NT server uses the directory and security databases from the Primary Domain Controller to determine user access rights. Backup controllers provide redundancy for WAN and remote servers, allowing remote users to remain logged on when connections are down.

In addition to administering users, Windows NT Server's directory services let administrators set permission levels to limit access to resources and file server directories. The User and Group Manager utility also lets the administrator assign users and resources to groups.

From the administrative side, however, Windows NT Server's directory services lack much of the depth and flexibility of those in NetWare 4.1 and Banyan's VINES. NetWare's NDS and Banyan's StreetTalk let you create multiple organizations in a single directory. This means you can easily segment your network into logical organizations such as "Acme International" and "Acme America." Windows NT Server only lets you define a single organization per domain. In order to share resources among several domains you have to go through a cumbersome process of setting up trusts among each set of two domains. *Trusts* enable users in one domain to access another domain's resources. This structure lets you technically set up NDS- or StreetTalk-like structures, but you still have to administer multiple directory services to maintain the trusted-domains labyrinth. Last July, Microsoft announced that it was working on Open Directory Services Interfaces (ODSI), a set of APIs that would allow compliant applications to access the directory services of any compliant NOS. The first set of specifications should be ready in mid-1996, according to Microsoft.

Windows NT Server provides a complex security system for controlling access within and between domains. An authenti-

cation process protects user information during log-on, encrypting passwords and user names. A series of directory and security databases store user and server information as Security IDs (SIDs). SIDs are also created when you want to link, or trust, one or more domains.

CONNECTIVITY CENTRAL

Windows NT Server's native protocol is NetBEUI, but the product also includes IPX/SPX and IP protocols, making it compatible with NetWare and TCP/IP networks. Windows NT Server also comes with the Gateway Service for NetWare, which lets non-NetWare clients running TCP/IP and connected to a Windows NT server access files on NetWare servers. Microsoft's Apple Services allow Macintosh users to store files on Windows NT servers and assign file and folder permissions that closely emulate AppleShare server permissions. Macintosh clients can also print to Windows NT printers from their regular LaserWriter Chooser icon.

With Windows NT Server, we found it relatively simple to set up complex configurations of multiple protocol and frame types.

Optional Windows NT Server products sold separately by Microsoft bring even more interoperability between NetWare and Windows NT servers. One product, File and Print Services for NetWare, makes a Windows NT server appear to NetWare clients as a NetWare 3.*x* server. Another product, Microsoft Directory Service Manager for NetWare, lets an administrator access a NetWare 3.*x* Bindery from a Windows NT server.

In addition to IP, Windows NT Server includes TCP/IP utilities, such as an FTP server, and helpful IP diagnosis tools, such as Ping. Windows NT's IP setup, which leads you through a series of dialog boxes, making it relatively simple to define IP addresses, gateways, and DNS server addresses. You still must know the IP addresses, but Windows NT Server guides you through the options. Windows NT Server also includes a Dynamic Host Configuration Protocol (DHCP) server to allocate IP addresses dynamically.

With Windows NT Server, we found it relatively simple to set up even complex configurations of multiple protocol and frame types. Hardware setup is especially simple. The product automatically detects adapter hardware and settings—as does OS/2 Warp Server—and uses pick lists and other interactive interface elements to make installation of complex networking components intuitive.

Like OS/2 Warp Server, Windows NT Server has built-in remote-access services. It uses Microsoft's Remote Access Service (RAS), allowing users to connect to Windows NT servers over analog and ISDN connections. In addition to the RAS client included with Windows 95, Windows NT RAS supports any PPP client. Once connected to the server, users can access the servers and resources as if they were directly connected to the Windows NT Server network.

Hard disk configuration tools are included with Windows NT Server. Using the graphical disk manager, administrators can partition and format individual disks with one any of the supported Windows NT Server file systems.

APPLICATIONS AND SERVICES

Microsoft's strategy to stack its Windows NT Server deck with a powerhouse of complementary applications and common services has produced a series of full-featured, robust applications and a handful of diagnostic and administration tools designed for Windows NT Server.

BackOffice, Microsoft's server application suite, comprises a half-dozen applications. BackOffice 1.5 is sold as a bundle starting at $2,199 with one administrator's license ($21,799 with 100 client licenses), or you can purchase the individual applications separately. Besides Windows NT Server, BackOffice includes the $999 Microsoft SQL Server 6.0 (for more information, see First Looks, September 26, 1995). Developed by individual Microsoft teams, BackOffice products share a common installation program and integrate to share resources. At the time of this review, Version 1.5 of BackOffice was shipping, but Version 2.0—which includes Microsoft Exchange Server—is expected by the time you read this.

The newest BackOffice family member is Exchange 4.0 ($699 base price; $6,099 with 100 clients), a MAPI-compliant client/server messaging and mail system. It exemplifies many integration benefits of applications and the Windows NT Server OS. Exchange, like other BackOffice products, takes advantage of Windows NT Server's directory services. If you have Exchange installed, you have the option of creating an Exchange user each time you create a new Windows NT Server user.

The accessibility of Windows NT Server's basic operating system functions lets BackOffice products work closely not only with the OS but with one another as well. For example, the System Management network administration package ($649 base price; $4,349 with 100-user license) works together with SQL Server. Taking advantage of SQL Server's powerful data manipulation and efficient client-server architecture, SMS uses SQL Server to log error messages. Users can monitor SMS activities by accessing SQL Server.

Similarly, the new Internet Information Server (IIS)—Microsoft's free Web server—can use Windows NT Server to publish Exchange documents on the Web or a corporate intranet. Using the Web Connector, a plug-in Service Provider Interface, IIS can convert Microsoft Exchange public-folders documents to Web pages on the fly, extending the availability of Exchange data to Web browser users.

SNA Server ($409 base price; $4,909 with 100-user license), another BackOffice application, is a simple and flexible product for providing connecting Windows NT servers to IBM mainframes and minicomputers such as the AS/400.

All the BackOffice applications use the included Event Log and Event Viewer applications for monitoring and collecting server information. The Event Log collects error and status messages, and the Event Viewer lets you open and read the actual messages. Any application can use the log to insert its own messages. While many third-party applications still rely on their own logs, the Event Log has the potential of being a central repository for information about all your network services.

From its powerful, scalable architecture

What's Available for Your NOS?

● Software available from the operating-system vendor
■ Software available from a third party
▨ Not available for this operating system

Products listed in alphabetical order	Microsoft Windows NT Server 3.51	NetWare 4.1	OS/2 Warp Server Advanced	VINES 6.0	UNIX-BASED NOSs: SCO OpenServer 5	SCO UnixWare 2.1	Solaris 2.5
Groupware and E-mail							
Banyan's BeyondMail	▨	■	▨	●	▨	▨	▨
Collabra Share, Client/Server Version	■	▨	▨	■	▨	▨	▨
DaVinci eMail	▨	■	▨	▨	▨	▨	▨
Lotus cc:Mail	■	■	●	■	▨	▨	■
Lotus Notes	■	■	●	▨*	■	▨	■
Microsoft Exchange Server	●	▨	▨	▨	▨	▨	▨
Novell's GroupWise	▨	●	■	▨	▨	▨	▨
SQL Databases							
IBM's DB2	■	▨	●	▨*	▨	▨	■
Informix-OnLine	■	▨	▨	▨*	■	■	■
Microsoft SQL Server	●	▨	▨	▨*	▨	▨	▨
Oracle7	■	■	■	▨*	■	■	■
Sybase SQL Server 11	■	▨	▨	▨*	▨	▨	■
Internet Servers							
IBM Internet Connection Server	▨	▨	●	▨	▨	▨	▨
Incognito Software's WebServer for VINES	▨	▨	▨	■	▨	▨	▨
Microsoft Internet Information Server	●	▨	▨	▨	▨	▨	▨
Netscape Enterprise Server 2.0	■	▨	▨	▨	▨	▨	■
NetWare Web Server NLM	▨	●	▨	▨	▨	▨	▨
Open Market WebServer	▨	▨	▨	▨	▨	▨	■
Process Software's Purveyor WebServer	■	■	▨	▨	▨	▨	▨
Directory Services							
Banyan's StreetTalk	▨	■	▨	●	■	▨	■
NetWare Directory Services (NDS)	▨	●	▨	▨	▨	▨	▨
SCO OpenServer Distributed Services	▨	▨	▨	▨	●	▨	▨
SunSoft's Network Information Service Plus (NIS+)	▨	▨	▨	▨	▨	▨	●
Other Services Available from the NOS Vendor							
Network management	Systems Management Server	ManageWise	SystemView (included)	OutLook for HP OpenView	SCO Doctor	None	Solstice
Mainframe connectivity	SNA Server	NetWare for SAA	PSF (printing), ADSM (backup)	VINES 3270/SNA	None	None	ONC+
Remote access	Remote Access Services (included)	NetWare Connect	Remote Connection Service (included)	PC Dial-in	None	None	None

* This product is available to VINES clients via native VINES IP or Banyan's Enterprise Network Services.

to basic file and print services, Windows NT Server is a well-rounded network operating system that is equally useful for small to medium-size, single-server or multiserver enterprise networks.—*Tony Pompili*

Microsoft Windows NT Server 3.51. Estimated street price: With 100-user license, $2,600. Microsoft Corp., Redmond, WA; 800-426-9400, 206-882-8080; fax, 206-883-8101; http://www.microsoft.com. *Circle 464 on reader service card*

Novell Inc.

NetWare 4.1

For years Novell's NetWare has been the dominant network operating system. NetWare 4.1 retains NetWare's excellent file and print services, on-the-fly disk compression, and top notch management tools. Other features and Novell products build on NetWare's file and print strengths to take NetWare closer to being a complete network operating environment. With NetWare Directory Services (NDS), NetWare 4.1 adds an excellent administrative directory for large multiserver, multisite Novell WANs. NetWare 4.1 also adds support for TCP/IP with NetWare IP. Novell's separate GroupWise is a robust messaging platform, and GroupWise XTD, scheduled for release in mid-1996, will come with even more groupware features and NDS support. Novell's NetWare Connect provides integrated remote access, Novell's ManageWise offers powerful management, and the recently released NetWare Web Server provides Internet server capabilities.

NetWare stumbles, though, when it comes to application services. Unlike Windows NT Server, NetWare runs only on Intel processors. And to get support for symmetric multiprocessing, you have to purchase a separate product, the recently released NetWare SMP 4.1. Like NetWare 4.1, NetWare SMP runs applications in NetWare Loadable Modules (NLMs), which are potentially unstable and, therefore, must be very carefully written. Furthermore, there is currently little integration among Novell's applications or between its applications and NetWare Directory Services.

Like Banyan Systems, Novell provides a powerful networking infrastructure that you can supplement with application services from other NOSs and third-party developers.

The Intranet and Your Next Network Environment

By Robert P. Lipschutz

In this roundup, we explore some of the new services offered by the current crop of network operating systems. But many of the answers to your internal network needs can be found right outside your firewall as familiar Internet applications. What's more, we feel the network of the future will inevitably be a fusion of NOS and intranet services.

An intranet can be thought of as any networking scheme that uses standard TCP/IP services within a corporate network (see "The Web Within," April 23, 1996, for an overview of intranets). One big advantage of intranet applications is that they're based on widely recognized standards, so customers aren't locked into single-vendor solutions. And although HTML pages served from http servers have made the biggest splash, other Internet technologies can also serve an intranet. Though your network environment in the future will be a blend of NOSs and Internet technologies, today you'll need to understand the overlap as well as the synergies. Here we look at four important network services: file and print, directory and naming, application, and communication.

FILE AND PRINT SERVICES

Robust file and print services are standard in most NOSs. On the intranet side, a network using Network File System (NFS), a file system developed by Sun Microsystems, can provide file sharing, but not with the fast performance of Microsoft Windows NT Server, NetWare, or OS/2 Warp Server. Also, user and group security is much better in traditional NOSs. We suggest you stay with NOSs for file and print services.

DIRECTORY SERVICES

Useful for both end users and administrators, directory and naming services connect users and groups with content and services. NOS directory services, such as NDS and StreetTalk, keep track of users, groups, files, and printers across entire enterprises. No comparable directory services are currently available for intranets, but the Internet provides useful content directories such as Infoseek and Yahoo. One combined directory service would simplify NOS and intranet management.

APPLICATION SERVICES

You can expect to see a combination of intranet and legacy applications in application services. Http clients provide an excellent front end for information retrieval from a variety of back-end databases. Web browsers are graphical, platform-independent clients with an intuitive interface familiar to many users. A three-tier approach is currently popular. An http client (the Web browser) talks directly to an http server that front-ends a standard SQL database server. Today, Common Gateway Interface (CGI) provides the mechanism for the http servers to communicate with the SQL database servers. It works, but it's slow.

Web server vendors such as Microsoft and Netscape are developing their own APIs to solve this performance problem. Application development will be easier because of standard http front ends but not dramatically, since there are not many canned applications for a Web-based environment.

Critical applications will probably continue to be housed on mainframes or RISC servers to take advantage of the better architecture, performance, and development environment they offer. Windows NT Server has made some strong inroads as an application server over the last year. Expect to see a combination of intranet and legacy applications here.

COMMUNICATION SERVICES

At the center of the information revolution is communication. Whether through e-mail or groupware, today's networks must facilitate effective collaboration. With today's networks, messaging is usually provided by such third-party applications as Lotus cc:Mail or Lotus Notes. Each package has its own particular client software, and back-end message processing is done through complicated gateways and e-mail switches.

With intranet products, everything works through standards such as SMTP, MIME, and POP3. This is an area where standards will simplify corporate networks: advantage intranets. The challenge is for the standards-based clients to match the features and functionality of the proprietary packages. Today, they just aren't there; they lack the versatile interfaces, advanced programmability, and database features of products such as Lotus Notes (for more information, see "Content and Collaboration," April 23, 1996). Netscape will probably take the lead here with its Web-server solution based on Collabra Share.

THE DIRECTORY

What makes NetWare 4.1 attractive to users running NetWare 3.*x*? Primarily, it is NetWare Directory Services. NDS, an X.500-like distributed directory, provides a centralized tool for managing multiple NetWare 4.1 servers and other network resources. It makes creating user accounts and setting access rights a snap, especially in a multiserver environment: You create an account once and it is replicated automatically to all other servers in the network. With NDS, NetWare 4.1 clients can have a single log-on to all network resources, regardless of where those services reside.

NDS's hierarchical structure is much more manageable than the domain model of Windows NT Server and Warp Server Advanced. With NDS, instead of domains, you create Organizational Units (OUs). To give a user access to resources in a different OU, you run the NWAdmin console and drag and drop the users' icons on the resources they need to access.

NDS is similar to the hierarchical directory services of Banyan's StreetTalk, but NDS's naming convention is more flexible. NDS does not impose a maximum number of naming levels, whereas StreetTalk permits a maximum of three (in the form User@Group@Organization). On the other hand, with unlimited naming levels the NDS structure can quickly become very complicated if it is poorly planned.

NDS is not, however, without its problems. Currently there are few applications that integrate fully with NDS. As a distributed directory, NDS must replicate information to all other servers throughout the network. This process can result in high-bandwidth utilization, especially across leased lines. Still, unlike Windows NT Server and Warp Server Advanced, which replicate the entire directory after every change, NDS transfers changes only among servers.

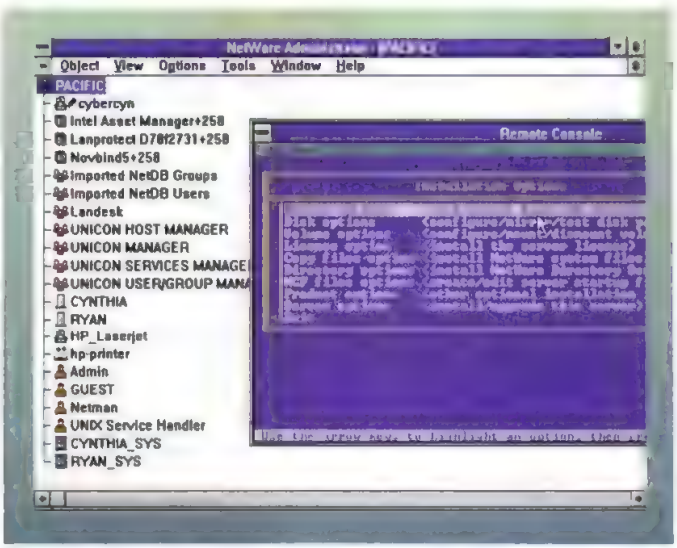
Because of its hierarchical structure, installing NDS in a large, widespread network can be complicated. But apart from NDS, NetWare 4.1's graphical installation is dramatically easier than NetWare 3.*x*'s. And though it lacks automatic hardware detection, a feature of Windows NT and OS/2 Warp servers, NetWare 4.1 is much simpler than VINES to install.

To encourage NetWare 3.12 users to adopt NetWare 4.1, Novell provides the Migrate utility to transfer Bindery information to NDS. Another tool, NetSync, lets you manage up to 12 NetWare 3.*x* servers from NWAdmin so that not all servers need to be upgraded at once.

SUITABILITY TO TASK

NetWare 4.1

	Power	Ease
File and print services	Good	Good
Directory and domain services	Good	Excellent
Environmental tools and applications	Fair	Good



NWAdmin graphically displays all of NetWare's resources, but some management tasks still require using a character-based interface.

FILE AND PRINT SERVICES

NetWare's core competency remains its robust, high-performance file service, with features such as internal routing, software-based RAID, and powerful printing functions. NetWare provides high-speed routing between multiple network adapters in a server for better throughput in a multisegment configuration. It is also the only product in our review that offers on-the-fly disk compression and suballocation.

Despite its powerful printing features, NetWare's print management is cumbersome. You can use NWAdmin to view print queues, but you must perform most printer management using two utilities, PSERVER.NLM and PCONSOLE .NLM. Both utilities are the same awkward C-Worthy applications from NetWare 3.*x*.

Managing NetWare 4.1 in general is easier than it was in previous versions. The graphical NWAdmin lets you perform most tasks (such as creating users and groups) from a single utility. Still, NWAdmin does not centralize everything. In addition to print management, rudimentary tasks such as creating disk partitions and modifying the AUTOEXEC.NCF files still require using a C-Worthy program.

For a fully redundant, fault-tolerant system, Novell offers NetWare SFT III ($1,495 for 100 users; $3,995 for an unlimited license). This solution lets you create a backup server with a configuration identical to the primary server's that mirrors the entire primary server. SFT III, however, does not yet work with some crucial services and applications, such as NetWare/IP.

NETWARE SMP

Because of its evolution as a lean, file-serving machine, NetWare has not been known for running CPU-intensive applications such as databases. Recognizing this, Novell developed NetWare 4.1 SMP, available only through third-party hardware vendors such as AST and Compaq, who bundle the product with their multiprocessor servers.

But NetWare SMP clearly is not a mature application platform. Currently, Oracle7 Server is the only product optimized for NetWare SMP. Unlike Microsoft and IBM, Novell does not sell its own database server for NetWare. Novell has promised SMP support with the next release of its GroupWise messaging product—GroupWise XTD. Another drawback to NetWare SMP is that the current implementation requires that applications be specifically written for that version of the NOS. For software developers, this means developing two versions of the software: an SMP version and a single-processor version.

NetWare also falls short when it comes to memory protection. All NLM applica-

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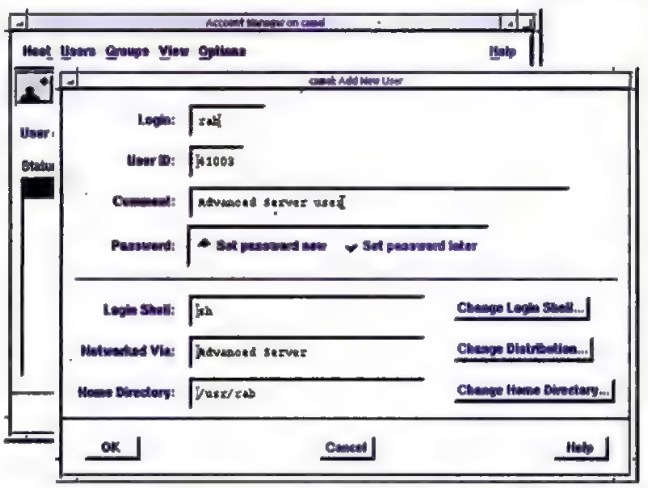
Unix Application Server, File and Print on the Side

By David S. Linthicum

Each of the network operating systems in this roundup is built around a core of file, print, and directory services. But if the needs of your network environment fall more heavily in client/server applications with file and print playing second fiddle, you may find that *x*86-based Unix operating systems such as SCO OpenServer, SCO UnixWare (purchased last year by SCO from Novell), and SunSoft's Solaris *x*86 Application Server are a better fit.

With their support for multithreading and symmetric multiprocessing, Unix-based operating systems provide a better home for client/server messaging and database applications than operating systems optimized for file and print services. (For reviews of Unix-based OSs as application servers, see "Serving Up Apps," October 24, 1995.)

The same operating systems can also provide file and print services for both native Unix and Windows clients. But they do so either through SunSoft's Network File System (NFS), which suffers from poor performance, or by layering products such as SCO's Advanced File and Print Server over the core OS to make it look like such popular file and print servers as NetWare and Windows NT Server. For smaller network environments in which application services are a priority, one of these Unix OSs can serve as the principal NOS. In a larger environment, they can provide application services plus some extra file and print services as needed.



SCO Advanced File and Print Server provides Windows NT–compatible services for OpenServer users.

SOLARIS APPLICATION SERVER

Solaris Application Server ($2,495 for one to four processors) is a combination of the Solaris *x*86 2.5 operating system and SolarNet PC Protocols Services. Solaris *x*86 provides symmetric multiprocessing, multithreading, and excellent fault-tolerance features. SolarNet layers on top of Solaris to provide base NetWare services and the IPX/SPX protocol stack for seamless integration with existing Windows and NetWare client environments. The IPX/SPX stack is implemented in parallel with TCP/IP and is available simultaneously. NetWare clients can therefore link to the Solaris Application Server without having to reconfigure or load additional protocols.

Setting up the application server is just a matter of installing the suite of products on a single- or multiprocessing PC system. But Solaris is finicky when it comes to hardware support, so make sure you read the hardware compatibility list before you decide to purchase Solaris. Moreover, Solaris Application Server is one product in a suite of Solaris products that can be confusing, so it pays to talk frankly with your SunSoft sales representative to find the most cost-effective way to meet your requirements.

Solaris's naming service, Network Information Services Plus (NIS+), can make several Solaris servers appear as a single information system. Like other global naming services (such as NetWare Directory Services), NIS+ provides a uniform distributed mechanism for managing network resources globally.

In addition to the NetWare file and print features, Solaris provides file and print services through NFS, a component of SunSoft's Open Network Connectivity Plus (ONC+). There are third-party NFS clients available for most operating systems including DOS, Macintosh, Windows 3.*x*, Windows 95, and Windows NT Workstation.

SCO OPENSERVER

SCO OpenServer provides support for up to 30 processors and good fault-tolerant features for running client/server applications. File and print services are provided through an add-on product, SCO Advanced File and Print Server. Advanced File and Print Server is a licensed version of Advanced Server for Unix (AS/U), developed by AT&T Global Information Solutions. It's also an enhancement to SCO's previous file-and-print product, LAN Manager for Unix (LMU) and is now fully compatible with and transparent to existing Windows NT Server clients.

Advanced File and Print Server can make your SCO OpenServer–based server look like a Windows NT file server, accessible by DOS, OS/2, Windows for Workgroups, Windows 95, and Windows NT Workstation clients. But at $995 (for a five-user license) for the Advanced File and Print Server software alone, plus the cost of the base OpenServer Enterprise operating system ($1,295 with a five-user license), it has the highest per-user cost of these three products.

In addition to file and print services, Advanced File and

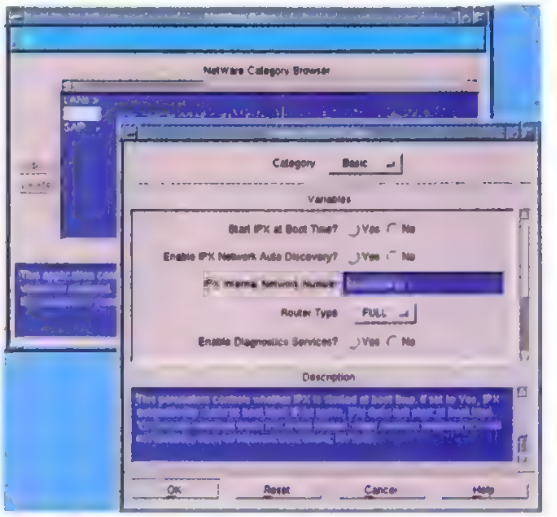
Print Server provides Windows NT network administration, monitoring tools, and utilities, and it includes NetBEUI and TCP/IP protocol stacks.

If you are concerned about security, you'll be happy to know that Advanced File and Print Server works directly with a trusted Windows NT domain server. Moreover, Advanced File and Print Server can share resources and user accounts in a Windows NT–compatible domain. It is also fully integrated into SCOadmin, Open Server's administration utility. Access control can be defined by user and group.

Installation of Advanced File and Print Server is just a matter of adding the software to an existing OpenServer environment through an automated installation process. Advanced File and Print Server prompts you to choose which protocols you want, automatically configures the network protocol stacks for you, and advertises the server to the clients.

File access seems slower than a true Windows NT file server, but printing performance was equivalent. Remember that you're using the SCO Open Server–based servers for application processing services as well as file and print services; performance, therefore, can vary depending on what else is tying up the disk and processor. Directory and naming services are equivalent to Windows NT, including support for long filenames.

Native Unix utilities keep the native Unix environment and simulated Windows NT server synchronized. Once Advanced File and Print Server is installed over the base OpenServer operating system, SCOadmin automatically creates the associated Advanced File and Print Server resources each time you add such resources as users or printer and file systems to SCO OpenServer.



UnixWare's NetWare integration utilities allow administrators to set such detailed information as IPX/SPX network configuration.

SCO UNIXWARE

SCO UnixWare Application Server is another example of a Unix OS that tries to look like NetWare. Until last year, UnixWare was a product of Novell, with NetWare file and print experience other Unix operating systems vendors only absorbed into SCO OpenServer, which could dilute its excellent file and print services.

At $1,695 (for 5 users, or $2,995 for 100 users) for both the base operating system and NetWare services, UnixWare is the bargain of this bunch. UnixWare is also based on the most recent version of the Unix kernel, System V Unix Release 4.2. SCO OpenServer and Solaris are based on older kernel versions, 3.2 and 4.0 respectively. UnixWare supports multiprocessing *x*86-based servers and provides a fault-tolerant file system as well as integration with TCP/IP and NetWare networking environments. UnixWare's Veritas journaling file system helps minimize downtime in the event of a power failure by logging file-system changes to disk as they occur.

UnixWare 2.1 includes NetWare 4.1 file and print services, and NetWare Directory Services (NDS), as well as the widest hardware support of these three products: 20 multiprocessing *x*86 server systems and 30 network interface cards. In addition, the base operating system is now optimized for the Pentium and Pentium Pro processors. We found UnixWare to be the best performer of the three.

As you might expect, the integration with NetWare is tight. UnixWare lets you map NetWare volumes using the UnixWare file system. It provides a NetWare Loadable Module (NLM), known as NetWare Unix client (NUC.NLM), that resides on the NetWare file server, providing UnixWare users and applications access to files on the NetWare server. UnixWare clients have access to shared NetWare printer services as well, all under the familiar blanket of NDS.

Installing UnixWare Application Server is effortless. UnixWare auto-detects most of the installation information. But there is some hands-on configuration required to add UnixWare user and group information for existing NetWare clients. Once set up, NetWare clients can log on to NetWare and browse files using either the Unix command line or built-in graphical utilities.

UnixWare also provides an MHS gateway to NetWare that allows UnixWare clients to exchange mail messages

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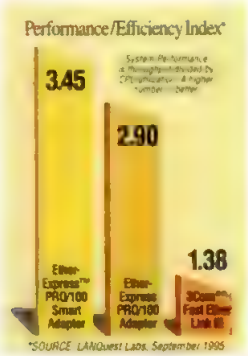

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EVALUATION TEST-BED

Network Operating Environments

We tested the entire network operating environment solution offered by each vendor. This included not only the file, print, security, and directory services but also messaging, remote access, Internet connectivity, and other essential network components.

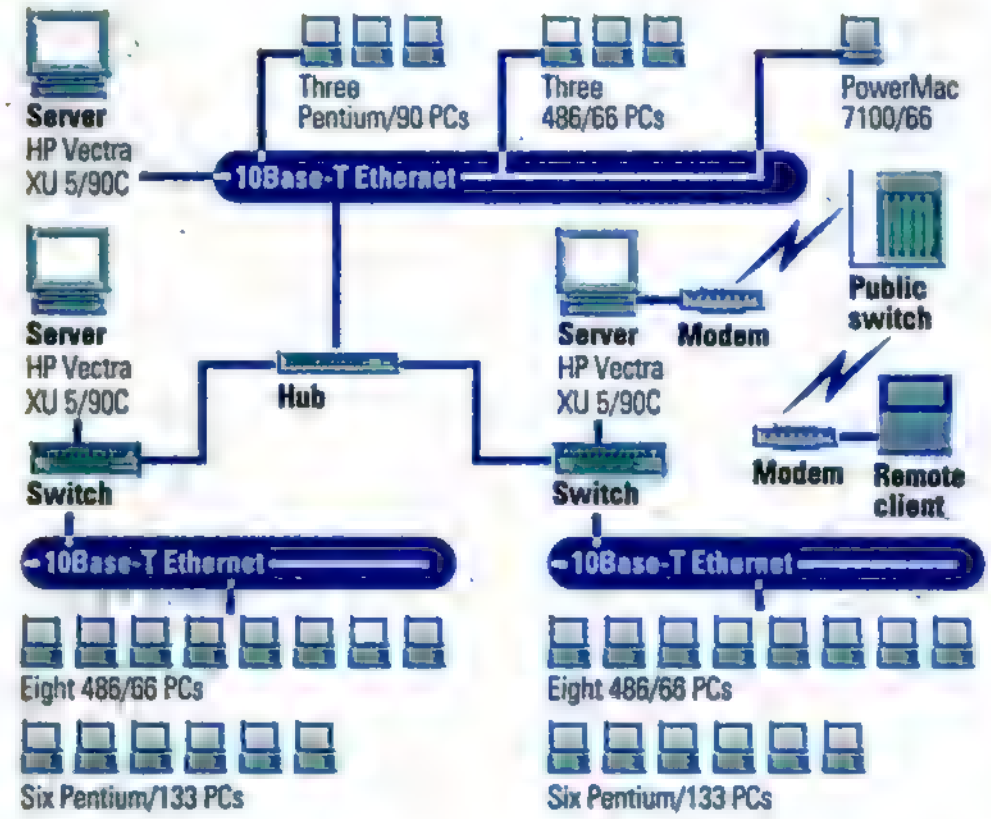
How We Tested

Today's NOSs and their additional services represent a movement away from a single-purpose network server to specialized resource servers that reside in different locations on the network. Testing these NOSs, their tools, and their applications required a test-bed to emulate a complex, heterogeneous environment.

First we installed and configured a single server to provide security and file and print sharing to eight clients variously running DOS, Macintosh, OS/2 Warp Connect, and all versions of Windows. We then tested and rated network installation, configuration, management, and fault-tolerance features.

We also examined each vendor's distributed computing framework. We added two servers and 28 additional clients to our network and ran the vendors' directory and domain services. We examined the logical rule-set or naming model to determine how well each vendor's naming service created relationships between directory objects and physical resources. We then rated the naming service's database on how well it could accommodate our simulated network. We moved and added users, groups, and physical devices to assess the distribution and synchronization of the directory or domain database.

Finally, we deployed each vendor's applications and integrated tools for database, messaging, remote access, groupware, and Internet servers. We tested the level of integration with the underlying operating system—for example, we looked at how effectively an application interfaces with the NOS's administrative and diagnostic tools—as well as the vendor's directory or domain service.—*Analysis written by Jeffrey G. Witt*



tions run at Ring 0, which offers higher performance but can cause the entire server to crash if one application misbehaves. Windows NT Server offers better memory protection, allocating to each application its own memory space. A single application, therefore, does not affect the operating system or other applications on the Windows NT Server. NetWare 4.1 does, however, let you test applications in the more secure Ring 3.

APPLICATIONS AND SERVICES

Novell claims NDS integration is crucial to an application's working seamlessly with NetWare 4.1, but very few line-of-business and vertical applications currently integrate with NDS. And many of the existing applications that do claim NDS integration actually provide very little NDS functionality. The NetWare/IP NLM, for example, is recognized by NWAdmin, but most of the management still takes place using a dedicated utility.

Novell also has not provided simple application tools, leaving NLM development for those intimately familiar with the complicated Novell C-Libraries (CLIB.NLM) and the Ring 0 architecture. In the next release of NetWare—codenamed Green River and scheduled to be available by the end of the year—Novell will add NET2000, a development tool and set of application programming interfaces (APIs). Developers and administrators alike will then be able to use tools such as Microsoft Visual Basic to develop applications for NetWare.

Even with the aforementioned limitations, hundreds of third-party applications covering all categories are available for NetWare 4.1.

Novell provides several core services for NetWare. NetWare Connect ($495 for two ports; $1,995 for eight ports) is a full-featured remote-access application that provides simple remote-access service to NetWare users (for more information, see "The Art of Being Remote," August 1995). Unlike with OS/2 Warp Server and Windows NT Server, remote access is not included as part of the NetWare operating system. NetWare Connect supports multiple connection methods, such as SLIP and PPP, but it is not as well integrated with the NOS as the remote access of Windows NT Server and OS/2 Warp Server. A remote client product called NetWare Mobile ($6,995 for 100 users) will have shipped by the time you read this.

Novell's ManageWise ($795 for five nodes) is a combination of tools that were previously sold separately but are now offered as a bundle (for more information, see "LAN Tamers," November 21, 1995). These applications include the NetWare Management System (NMS) network management platform, NetWare LANalyzer, and Intel LANDesk (a suite of network management packages including software distribution, hardware inventory, and other functions), along with some

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SUMMARY OF FEATURES

Continues

Network Operating Systems

■ YES ▫ NO

Products listed in alphabetical order	Microsoft Windows NT Server 3.51	NetWare 4.1	OS/2 Warp Server Advanced	VINES 6.0
List price (100 users)	$3,299	$6,995	$629	$9,950
General Features				
Minimum hard disk space required	90MB	21MB	120MB	150MB
Maximum hard disk space supported	708 billion TB	32TB	Unlimited	384GB
Minimum RAM required	16MB	8MB	16MB	12MB
Maximum RAM supported	408 million TB	Unlimited	512MB	256MB
Preemptive multitasking	■	■	■	■
Cooperative multitasking	▫	▫	▫	▫
Virtual memory kernel	■	▫	■	■
Real memory kernel	■	▫	■	▫
Symmetric multiprocessing	■	▫*	▫	■
CPU types supported:				
Intel x86/Digital Alpha	■■	■▫	■▫	■▫
HP-PA RISC/MIPS	▫■	▫▫	▫▫	■▫
Motorola PowerPC/Sun SPARC	■▫	▫	▫▫	■■
Application-memory protection	■		■	■
Internal routing	▫	■	▫	▫
File systems supported:				
FAT/HPFS	■■	▫▫	■■	▫▫
NTFS/VINES file system	■▫	▫▫	▫▫	▫■
NetWare file system	▫	■	■	
NFS	Optional	Optional	Optional	▫
Native backup service	■	■	■	■
Native remote access	■	Optional	■	Optional
Peer-to-peer functions	■	▫	■	▫
Server Disk Options				
Data compression by file/by directory	■■	■■	▫	▫
Data-block suballocation	▫	■	▫	
Transaction-based file system	■	■	■	
Maximum file size	17 billion GB	4GB	2GB	2GB
Maximum volume size	17,000TB	32TB	64GB	24GB
Maximum partition size	Size of disk	Size of disk	64GB	2GB
Maximum volumes	25	64	26	16
Software disk striping	■	■	▫	▫
Duplexing/Mirroring	■■	■■	■■	■■
Software-based RAID levels supported	0, 1, 5	0, 1	1	0, 1, 5
Directory and Naming Services				
Hierarchical structure/Domain structure	■	■	■	■
Distributed database	■	■	■	■
Replicated database	■	■		■
Automatic synchronization		■		■
Auto-discovery of resources	▫	■	▫	■
Location-independent log-on	■	■	■	■
Single-user log-on	■	■	■	■
Single-application log-on	■	■	■	■
Global network view				■
Object searching and browsing		■		■
Management functions from single point/ from multiple locations	■■	■■	■■	■■
Drag and drop of resources		■	■	■
Unlimited naming scheme		■		■
X.500-compliant	■	■		■
Cross-platform support	▫		▫	■
Predefined objects	■	■	■	■
User-defined objects/attributes		■■	■■	■■
Authentication of services and users	■	■	■	■
Access-control list for users	■	■	■	■

* This feature is available in NetWare 4.1 SMP, bundled with third-party multiprocessor servers.

virus-scanning software. ManageWise is not as well integrated as Microsoft System Management Server (SMS), which operates as a single application with other network services.

Novell's messaging strategy revolves around GroupWise ($1,320 for ten users). GroupWise offers e-mail capabilities, group scheduling, and even some impressive telephony features that can integrate your e-mail in-box with your voice mail. But the product does not yet have the advanced discussion capabilities of groupware products such as Lotus Notes. The next version, GroupWise XTD, will include discussion features and full integration with NDS.

Internet tools for NetWare have been scant until recently, partly because NetWare runs on its own SPX/IPX protocol instead of TCP/IP. The free NetWare/IP 2.2 brings enhanced TCP/IP functionality to NetWare LANs, providing Dynamic Host Configuration Protocol (DHCP) capability to allocate IP addresses dynamically. NetWare could start to make inroads as an Internet platform in conjunction with the recently released NetWare Web Server ($995) from Novell; Novell's LAN WorkPlace ($995) and LAN WorkGroup ($6,995 for 100 users), which provide MS Windows and DOS users with a TCP/IP stack; and third-party tools such as Firefox's NOV*IX for NetWare ($11,795 for 100 users), which acts as a IPX-to-IP gateway.

NetWare 4.1 is still an attractive file and print server, and NDS provides large networks with an excellent management tool. But NetWare's complex application-development environment could impede its acceptance as a complete network operating environment.—*O. Ryan Tabibian*

NetWare 4.1. List price: For 100 users, $4,200. Novell Inc., Provo, UT; 800-638-9273; fax, 801-429-5499; http://netware.novell.com. *Circle 465 on reader service card.*

IBM Corp.

OS/2 Warp Server Advanced

With OS/2 Warp Server Advanced, IBM has integrated many of the functions necessary for a full network operating environment into the NOS itself. In addition to basic file and

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CIRCLE 243 ON READER SERVICE CARD

H-604-6

SUMMARY OF FEATURES

Network Operating Systems

Ends

■ YES ▨ NO

Products listed in alphabetical order	Microsoft Windows NT Server 3.51	NetWare 4.1	OS/2 Warp Server Advanced	VINES 6.0
Network Security				
Password restrictions:				
Aging	■	■	■	■
Force changes	■	■	■	■
Encryption across the wire	■	■	■	■
Specify length	■	■	■	■
Account expiration by date	■	■	■	■
Offers intruder detection and lockout	■	■	■	■
Limit resources by user name	■	■	■	■
Limit resources by group	■	■	■	■
Access-control on per-file basis	■	■	■	■
User disk space can be limited	■	■	■	▨
C2 certification:				
Orange Book	■	▨	▨	▨
Red Book	▨	■	▨	▨
Network Printing				
Supports printers on server/client/wire	■■■	■▨■	■■■	■■■
Allows multiple queues for one printer	■	■	■	■
Allows multiple queues for multiple printers	■	■	■	■
PostScript support	■	■	■	■
Remote queue management	■	■	■	■
Protocol Support				
AppleTalk	■	■	▨	■
DHCP	■	■	■	▨
DLC	■	■	■	▨
IPX/SPX	■	■	■	■
NetBEUI	■	▨	■	▨
NetBIOS	■	■	■	■
TCP/IP	■	■	■	■
TCP/IP tunneling	▨	■	▨	■
VINES IP	▨	▨	▨	■
Server Management				
Offers remote console	■	■	■	■
Alert notification	■	■	■	■
Remote control of client	▨	▨	■	▨
Software distribution	Optional	Optional	■	▨
Console displays:				
Error and system status logs	■	■	■	■
Cache utilization	■	■	■	■
Hard disk information	■	■	■	■
LAN driver statistics	■	■	■	■
Logical-disk statistics	■	■	▨	■
Number of open files	■	■	■	■
Paging statistics	■	■	■	■
Percentage of CPU utilization	■	■	■	■
Physical disk statistics	■	■	■	■
Session statistics	■	■	■	■
CMIP agent	▨	▨	▨	▨
DMI agent	▨	▨	▨	▨
SNMP agent	■	■	■	■
Client OS Support				
DOS 3.x or later	■	■	■	■
Macintosh System 7.5	■	■	Optional	■
OS/2 2.11 or later	■	■	■	■
Windows 3.1	■	■	■	■
Windows 95	■	■	■	■
Windows NT Workstation 3.5	■	■	▨	■
Windows for Workgroups 3.11	■	■	■	■

print services, Warp Server Advanced comes with LAN Distance remote-access software and a group of utilities for basic system management, software distribution, software and hardware inventory, and network backup and restore. And although Warp Server Advanced doesn't yet support symmetric multiprocessing (SMP), it works well as an application server OS for many existing applications, including IBM's own DB2 database server, Lotus Notes messaging and groupware, and the IBM Internet Connection Server. Gupta, Oracle, and Sybase also offer database products for Warp Server Advanced.

IBM plans to integrate SMP into Warp Server Advanced later this year, but unlike Microsoft Windows NT Server, Warp Server Advanced will continue to run only on Intel microprocessors. Later this year IBM also plans to offer a suite of back-end applications similar to Microsoft BackOffice.

One major piece missing from Warp Server Advanced's network environment is full, global directory services similar to Novell's NDS and Banyan Systems' StreetTalk. So for now Warp Server Advanced works best as a solution for small to medium-size networks. Later this year, however, IBM plans to introduce its own global directory services component as an add-on to the NOS.

Before OS/2 Warp Server, you had to purchase two packages—OS/2 and OS/2 LAN Server—and do two separate installations in order to get your OS/2 LAN Server network up and running. Not anymore. Based on the 32-bit OS/2 Warp kernel, Warp Server Advanced includes OS/2 LAN Server.

TWO FLAVORS

OS/2 Warp Server Advanced supports up to 1,000 users on a single server. For smaller networks there is the basic OS/2 Warp Server, which supports about 120 users per server for file and print sharing. The basic Warp Server lacks IBM's High Performance File System and many of the fault-tolerance and management features of the Advanced product.

Warp Server runs TCP/IP and provides a gateway to IPX for NetWare file and print services. Warp Server Advanced also includes what IBM calls Dynamic IP, which integrates the Dynamic

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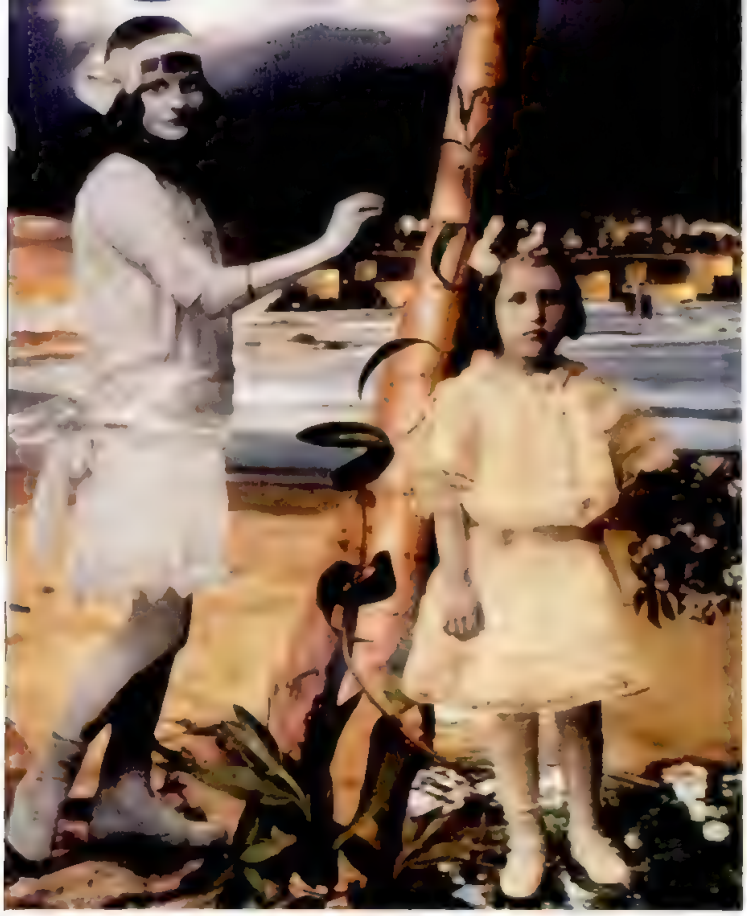

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CIRCLE 252 ON READER SERVICE CARD

Host Configuration Protocol (DHCP) and Dynamic Domain Naming Services (DDNS) to make it easier to keep track of the TCP/IP address on your network.

While fairly easy to install, Warp Server Advanced had a slight problem with our server configuration. Like Windows NT Server, Warp Server Advanced autodetects hardware during installation and includes drivers for more than a hundred network adapters. The installation routine properly detected our 3Com adapter, but it did not load the driver until we manually entered the card's Ethernet address. We didn't find this problem mentioned in any of Warp Server Advanced's documentation. After we cleared that hurdle, installation proceeded smoothly, and Warp Server let us choose whether to install such additional components as remote access, backup, and management.

DOMAIN EVENT

Warp Server Advanced uses a domain structure similar to that of Windows NT Server to provide a directory of all users and resources on the network. You can set up domain controllers to monitor multiple servers and domains. A domain controller keeps track of all of the users, resources, and security information for all of the servers in the domain. You can also build accounts and define privileges for users in more than one domain, so that users can access servers in multiple domains with a single log-on. This requires more work than setting up trusted domains in Windows NT Server.

Unlike NetWare Directory Services (NDS) or StreetTalk, Warp Server Advanced's domains do not provide global management capability. With NDS, for example, you can use a single PC to set up all of your users, servers, and other network resources; it doesn't matter where the server is or how many servers you have.

IBM's global directory service, called Directory and Security Services (DSS) and scheduled to be available by mid-1996, will allow you to manage users and resources from a single location. DSS, which like NDS and StreetTalk, provides a hierarchical network naming structure, is based on the Distributed Computing Environment (DCE) initiative from the Open Systems Foundation (OSF) and provides a standard infrastructure across the entire corporate network.

FILE AND PRINT SERVICES

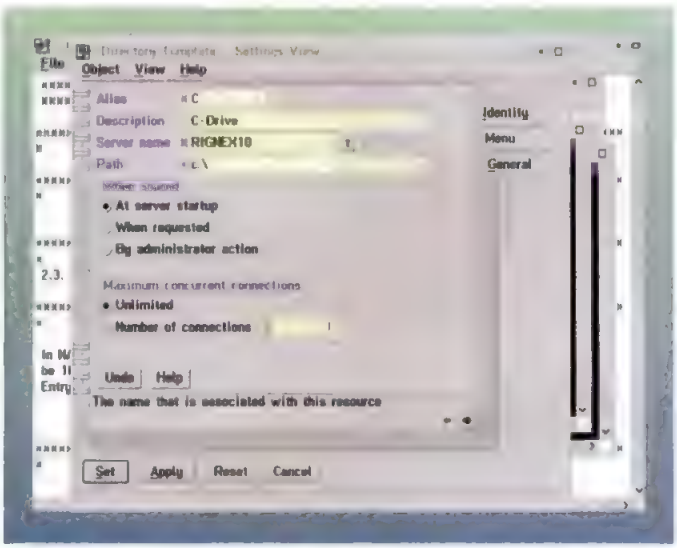
Similar to Windows NT Server, Warp Server Advanced file and print services function completely in peer-to-peer mode. Warp Server Advanced comes with all the software you need to let any network user with the appropriate rights share drives and printers with other Warp Server Advanced file servers and with PCs running Warp Connect, DOS, Windows for Workgroups, and Windows 95. Using Warp Server Advanced's Gateway Services utility, you can also connect to a NetWare server and give clients on the Warp Server Advanced LAN access to NetWare drives and printers. IBM also offers Macintosh client software, sold separately.

Warp Server's Advanced Printing Services (APS) allow bidirectional communications with some printers, such as those from Lexmark. The bidirectional feature allows clients to receive such response codes from printers as an out-of-paper message. APS also allows you to print to large, line printers that are connected to minicomputers and mainframes. The most exciting feature of printing in Warp Server is the ability to send PostScript jobs to non-PostScript printers.

SUITABILITY TO TASK

OS/2 Warp Server Advanced

	Power	Ease
File and print services	Good	Fair
Directory and domain services	Fair	Fair
Environmental tools and applications	Good	Fair



OS/2 Warp Server's templates use a familiar tabbed interface to set up shared directories as well as other resources such as printers.

APPLICATIONS AND SERVICES

By the time you read this, IBM will have announced its back-end application suite, code-named Eagle. These products will include new versions of IBM's database and transaction servers. All of these products will be more tightly integrated with the Warp Server Advanced OS, including a smart install option that determines what platforms you are running, according to IBM. IBM is also working on a new version of its OS/2-based Web server, Internet Connection, that will be free to Warp Server Advanced users. Currently IBM sells the Internet Connection Server for $799.

Some of our favorite features of Warp Server Advanced are the SystemView administrative and management tools, which are bundled with the base NOS. With SystemView, you can keep a detailed software and hardware inventory of all of your client PC and server systems on the network. You can also distribute software updates to all of your client PCs and control software licenses. In order to gather information and monitor other PCs, you must install the SystemView agents on all your PCs. The agents are included in the client license and are part of the client software.

On our tests, we were able to determine the type of CPU, amount of RAM and disk space, and even the applications installed on all of our network PCs. The System Management tools also allow you to monitor the performance of your file server and allocate available system resources to clients. OS/2 Warp Server also offers a more powerful server management solution in NetFinity. NetFinity lets you manage all of your servers—even NetWare servers—from a central location and

provides detailed hardware information.

Unlike NetWare, Warp Server Advanced comes with powerful remote-access software. Remote Connection Service (RCS), which is also sold separately by IBM as LAN Distance, allows you to establish as many as 128 remote-node connections to a single Warp Server Advanced system. (For more information, see "The Art of Being Remote," August 1995.) You can connect using most network protocols, including IPX, NetBEUI, and TCP/ IP, from DOS-, OS/2- and Windows-based PCs. In general, however, RCS is complicated to set up and use unless you are calling from an OS/2 client.

With its well-honed StreetTalk III, VINES 6.0 provides the strongest directory services of any product in this review.

In addition to these built-in utilities, IBM offers two powerful database applications—DB2 and Lotus Notes. DB2 ($369 for a single-user license; $1,495 for multiple users) is a powerful database server that runs on several different platforms, including Warp Server Advanced. It allows you to exchange information between mainframes, minicomputers, and PC-based LANs. We found it easy to install, but DB2 will require weeks to master if you're unfamiliar with it.

For groupware and e-mail, IBM's strongest solution is Lotus Notes. The most powerful and best known groupware platform on the market, Notes ($495 per server) allows you to host threaded discussions among users on the network, share data, and write custom work flow applications. Notes is not limited to Warp Server Advanced; it's also available for other NOSs, including NetWare and Windows NT Server. IBM plans to continue to offer Notes on multiple platforms but has promised to provide the best integration with Warp.

IBM offers another family of strong messaging products, MQSeries ($495), for Warp Server Advanced. MQSeries is both a messaging and transaction service that runs on 21 different platforms, including all IBM platforms and Unix flavors from Digital, Hewlett-Packard, and SunSoft. Two of the strongest selling points of MQSeries are its guaranteed delivery and its ability to exchange data between PCs and mainframes. IBM is also working on providing tighter integration between Lotus Notes and the MQSeries middleware.

Warp Server Advanced includes an impressive set of built-in utilities and an even more impressive choice of optional products. But though IBM has laid the groundwork for providing an entire solution, it's missing a powerful directory service and a directed back-end application suite. IBM has promised both of these in the near future, but until then you need to find these features in other products.—*Steve Rigney*

OS/2 Warp Server Advanced. List price: With 1,000-user license, $1,299 per server. IBM Corp., Armonk, NY; 800-426-3333; http://www.ibm.com. *Circle 466 on reader service card.*

Banyan Systems Inc.

VINES 6.0

With its well-honed StreetTalk III, VINES 6.0 provides the strongest directory services of any product in this review. Its file and print services are good, and Banyan's messaging offerings—BeyondMail, Microsystems Software's CaLANdar, and Netscape's Collabra Share—provide an excellent productivity platform. BeyondMail is especially well integrated with StreetTalk and VINES's Intelligent Messaging III. Where VINES falls short as a total network environment solution is in application services: It is limited by a maximum file size of 2GB, meager third-party application development, and poor performance. Finally, Banyan offers little in the way of Internet or remote-access solutions. But Coordinate.com, Banyan's recently formed Internet division, may address some of these concerns.

VINES also has some weaknesses that lie beneath the surface: an aging Unix operating system, occasionally arcane management procedures, and the most limited server hardware support of the products we reviewed. Although Banyan does its best to shield VINES users from its Unix roots, our installation was difficult. One prominent example: VINES has no hardware auto-detection as do Windows NT Server and Warp Server Advanced.

The VINES supported hardware list is still quite meager, but a developer's toolkit now allows third parties to develop VINES drivers for SCSI and network adapters. Most of our initial installation time was spent loading options one by one into our server key—a parallel-port device that VINES requires. Long-time sufferers of this anachronistic protectionism will be elated that the next VINES release will do away with parallel-port dongles entirely.

VINES file and print services are on a par with their peers. Both server- and workstation-connected printers are supported. Keeping client data safe requires rigorous backup procedures, and VINES's base-level backup functionality exceeds that of Windows NT Server but falls far short of Warp Server Advanced's. We found that Banyan's Enterprise Backup and Restore ($3,000 with two agents)—a separately sold version of Legato's Networker—gives more complete protection for both server and desktop disk drives.

DIRECTORY SERVICES

As the granddaddy of LAN-based directory services, StreetTalk III remains the simplest to execute and maintain.

StreetTalk's three-tier naming convention (in the format User@Group@ Organization) is less flexible than NDS's architecture, which lets you nest properties infinitely. But the use of StreetTalk Attributes, along with the Nicknames feature, gives the system sufficient malleability, and the tier limit makes for less clutter. Attributes—any additional information assigned to a StreetTalk object—can be ascribed by an administrator or third-party developer for their own purposes; unlike NDS schema extensions, they need not be globally defined. Nicknames lets you assign a simple, one-word alias to resources as well as to users.

Another advantage of StreetTalk over NDS is that, in the StreetTalk architecture, each VINES server is responsible only for the groups residing on it. So, unlike with NDS, adding a user results in no server-to-server traffic.

StreetTalk is also available for multiple NOS platforms, a capability NDS lacks. Enterprise Network Services (ENS) is Banyan's StreetTalk directory ported to several more robust Unix variants and Novell's NetWare. ENS allows NetWare, Unix, and native VINES clients to share a common directory system and use a common directory service for a cohesiveness unmatched by any other current NOS. Banyan also recently announced StreetTalk for Windows NT, which allows VINES users to access Windows NT Server's file and print services directly.

In older versions of VINES, when a user's home server went down, that user was denied access to the entire network. Recognizing this weakness, Banyan added a group shadowing feature to StreetTalk in VINES 6.0. It lets you specify secondary and tertiary servers.

With much of the StreetTalk information distributed across the enterprise, VINES users can call upon the StreetTalk Directory Assistant (STDA) for faster resource lookups. STDA, which resides on a user's local server, scans all servers on the network periodically to gather relevant StreetTalk catalog information. While STDA helps mitigate unnecessary bandwidth usage, the information is not delivered to users in real time.

ADMINISTRATION

VINES requires that some administrative duties such as hardware configuration take place at the server console, but the graphical ENS Management Tool (MT) now takes much of the drudgery out of day-to-day operations. ENS MT, which runs on a Windows client, allows varied resource search methods and uses a tabbed options interface. Administrators running ENS for NetWare can manage their Novell servers from ENS MT also, but this requires both IPX and VINES IP protocol stacks.

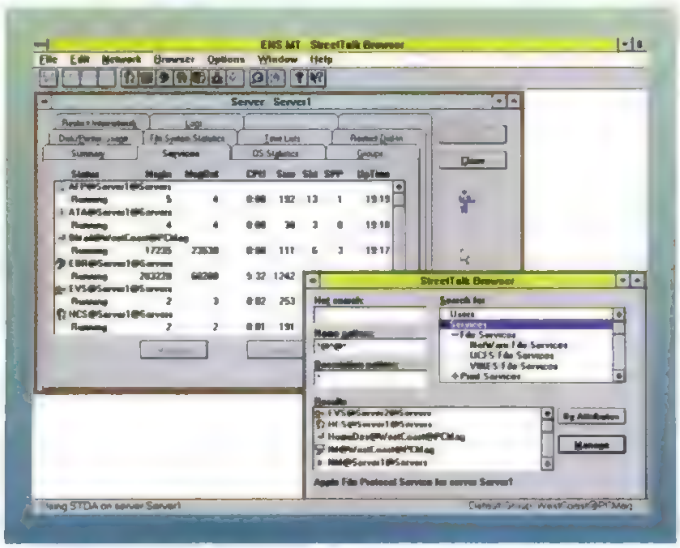
Along with ENS MT, we tested Banyan's OutLook for HP OpenView ($3,290 with one agent), which is a Simple Network Management Protocol (SNMP) management platform. OutLook extensions allowed us to view SNMP devices while monitoring and managing our VINES test servers. And in addition to automatically mapping our installation, OutLook let us view and graph such server statistics as CPU usage and system loading.

We found basic SNMP setup on the VINES server simple enough, but the voluminous documentation for Banyan's optional History Collection Service left us reeling.

SUITABILITY TO TASK

VINES 6.0

	Power	Ease
File and print services	Good	Fair
Directory and domain services	Excellent	Excellent
Environmental tools and applications	Fair	Fair



VINES includes the ENS Management Tool, which lets you browse detailed StreetTalk information for all of your network resources.

SCALABILITY

As an option, VINES supports multiprocessor hardware, but other aspects of this NOS hamper its scalability—namely VINES's 2GB maximum file-system size. With corporate data migrating to PC-class servers, this limitation has become increasingly problematic. Banyan's StreetTalk for Windows NT, which allows users to host VINES files on Windows NT Server, can circumvent this shortcoming, as can installing Banyan's ENS on another server.

VINES supports most major protocols, and it can tunnel VINES IP over IP, IPX, and even SNA. With none of the hassles associated with traditional TCP/IP, such as having to assign IP addresses manually, native VINES IP is much easier to use. But for sites looking to run only IP, Banyan offers client software for TCP/IP. Wide-area connections over ISDN, Frame Relay, T1/E1, X.25 and dial-up lines are all possible using Banyan's Intelligent Communications Adapter.

APPLICATIONS AND SERVICES

Banyan's approach to network services is different from Microsoft's and IBM's. While Banyan doesn't offer an SQL database itself, users can deploy a powerful system using Banyan ENS with IBM's AIX, HP-UX, or Solaris, and the database of your choosing.

Banyan does, however, offer a powerful amalgam of messaging software products that are deeply integrated with one another and the underlying NOS. All the applications use StreetTalk for user data and Intelligent Messaging III as the message-transport layer. Banyan's BeyondMail (standard version, $4,500 for 100 users) has very powerful rules-processing abilities. A new version now fully supports POP3 and SMTP mail protocols and makes it possible to embed such items as URL links in messages.

Best of all, not all users must be running the BeyondMail client software to exchange e-mail with one another. After creating a message using the BeyondMail Windows client, we retrieved it with VINES mail on an OS/2 system.

Two other packages, Netscape's Collabra Share ($6,995 for 100 users; reviewed in "Let's Talk," November 21, 1995) and Microsystems Software's CaLANdar ($595 for 10 users), a group scheduling product, help flesh out Banyan's groupware strategy.

Rounding out Banyan's messaging solution, both packages make good use of VINES' infrastructure via the StreetTalk directory, STDA, and Intelligent Messaging III services.—*William F. Katz* □

VINES 6.0. List price: $9,995. Banyan Systems Inc., Westborough, MA; 800-222-6926, 508-898-1000; fax, 508-898-1755; http://www.banyan.com. *Circle 467 on reader service card.*

ER Diagramming Tools: Power Through Perspective

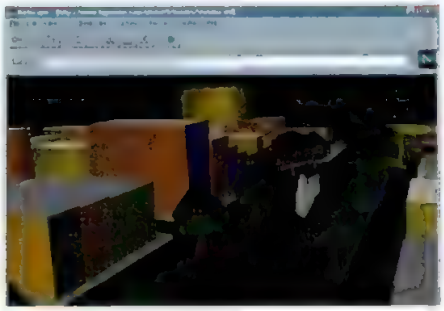
Three sophisticated database design tools bring order to the chaos of client/server development.

By Brian Butler

You can build a tree house without a blueprint, but you'd be hard-pressed to build a real house the same way. Yet that's exactly what many developers attempt when building client/server systems. Tools like Microsoft Enterprise Manager or PowerBuilder's DataPainter make it quick and easy to create databases, tables, and indexes on the fly with little regard for referential integrity, consistency, or functionality. But as projects grow, they often hit a wall because of inadequate data integrity constraints and poor database performance. This syndrome has left many thinking that client/server architectures simply won't scale to enterprise proportions. Don't blame the architecture or the tools. The problem is that you tried to build a complex structure without a plan.

ILLUSTRATION BY KEN CONDON

IN THIS SECTION



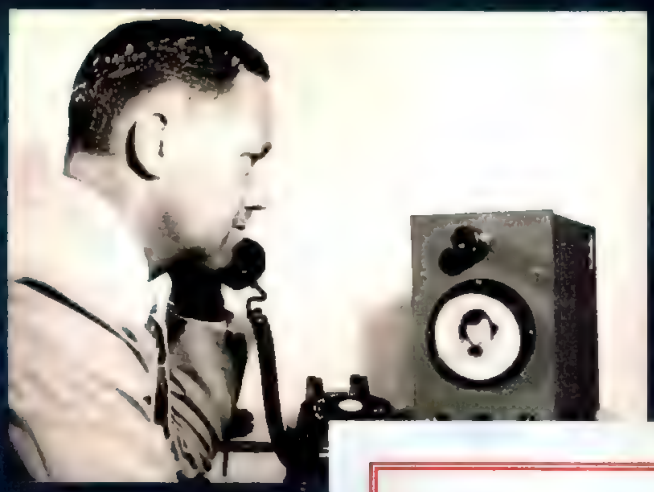
TUTOR Virtual reality comes to the Web: Find out how to create 3-D worlds in which you wander around and link to other Internet sites. VRML (Virtual Reality Modeling Language) is the text-based description language that makes it all possible. *page 196*

INSIDE WINDOWS 95 The Exchange Inbox included with the operating system is a powerful universal mail client, but it's very sparsely documented. Here are some clues as to how you can harness some of its powerful features. *page 199*

INTERNET TOOLS The continuing hunger for more, better, and faster access to information, along with easier acquisition, storage, and distribution of that information presents a need that's difficult to meet. We take a look at how Lotus's new InterNotes meets that challenge. *page 207*

UTILITIES Our MultiLaunch utility is a Windows 95 shell extension that lets you associate any number of programs with any file type. This means, for example, that you can choose among Notepad, Wordpad, and WordPerfect to launch a plain .TXT file. *page 217*

ALSO IN THIS ISSUE In PC Solutions we present a program that will display a DLL's module definition string. We also tell you what your options are if you want to add a CD-ROM drive to a system that already contains two IDE disks, explain how to size a DOS window in OS/2, present a way to convert calendar dates to Julian dates in Microsoft Access for Windows 95, and more. *page 223*



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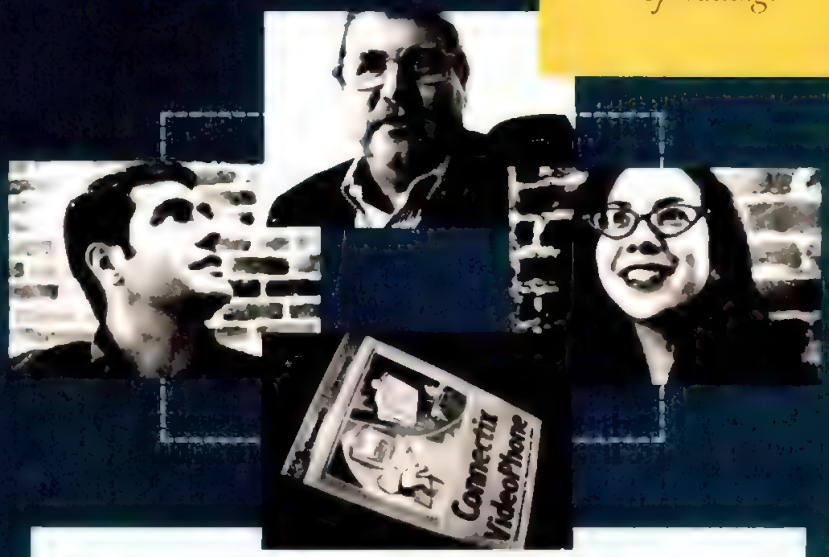

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CIRCLE 076 ON READER SERVICE CARD

In this roundup, we look at three visual CASE tools for developing and generating entity-relationship (ER) models and database schemas: ER/1 1.0, from Embarcadero Technologies, ERwin/ERX 2.5, from Logic Works, and S-Designor 4.2.1.0, from Powersoft. These models are the design blueprints you need to have a clear overview of complex development projects. All three also let you generate scripts for all widely used SQL databases.

S-Designor 4.2.1.0

An ideal ER diagramming tool will let you focus your efforts on database design, freeing you from worrying about the specifics of a particular back end. Although all three tools reviewed here let you create and reverse-engineer attributes, enforce database integrity, and automatically generate database schemas, Powersoft's S-Designor stands out for doing the best job of enabling high-level database design.

S-Designor's most impressive feature is its strict separation of conceptual and physical models. It forces you to concentrate in logical terms, completely abstracted from the underlying physical implementation. Instead of thinking in terms of tables, columns, and foreign keys, you are able to conceptualize your design in terms of entities, attributes, and relationships. Conversely, when you work with the physical model, you can make implementation and performance tweaks without muddying the conceptual design. S-Designor's ability to generate PowerBuilder DataWindows lets you get a working PowerBuilder application off the ground quickly, making it possible to test the viability of a given solution with real data.

S-Designor's interface is clean and usable, with most of the modern amenities you'd expect. The only significant features we missed were two-way synchronization capability and object-level data dictionary locking.

We continue to be impressed with ERwin, a technically sound and stable ER tool with a well-deserved reputation for solid work. Its powerful two-way synchronization lets you apply changes in the logical model to the physical database, and lets you propagate changes in the physical model into the logical model. We were disappointed with its awkward interface, which will discourage users from taking full advantage of its many strengths.

ABSTRACT REPRESENTATIONS

ER diagramming tools let you focus on the conceptual design by isolating it from aspects of the implementation that are specific to a particular physical back end. An important corollary of this approach is that the model doesn't become dependent on a particular back end. This facilitates migration between different database vendors, if required.

ER diagramming tools represent the database in the abstract by treating tables as entities, columns as attributes, user types as domains, and so forth. Though the semantics differ among different design methodologies, the concepts are similar. An ER diagram represents the database model as a graphical image, where entities are represented by boxes, and lines between the boxes represent the relationships between those entities. Each line has a special symbol at the end that provides a visual representation of the cardinality between entities (for example, one-to-many or zero-or-more-to-one). The user can optionally describe the relationship between entities with a verb phrase, making the diagram easier for the nonprofessional to read.

TESTING FOR THIS STORY

Many reviews look at ER diagramming tools strictly in the context of new development. Those reviews typically test by starting with a fresh diagram, designing a database, then generating the data definition language (DDL) scripts and the physical database from the design. We took a different approach, since we often see developers create databases in the course of a project only to find later that the architecture has become hopelessly unwieldy. It's at this point that many decide to invest in an ER diagramming tool.

> Many decide to invest in an ER tool only after they discover that their architecture has become hopelessly unwieldy.

Instead of starting a fresh database design project, our tests called for reverse-engineering an existing database, refining and extending its design, implementing our newly revised version, and finally documenting the new application using each tool's reporting features.

The first step in testing all the tools was to reverse-engineer an existing 120-table Microsoft SQL Server 4.2 database. We attempted to do this both through a direct database connection and using a SQL DDL script. We found that each product supported all of the major database back ends and could easily gather a database's major component definitions (including attributes, tables, columns, primary and foreign keys, triggers, stored procedures, and user-defined data types). Only ERwin was able to gather all the storage information (segments and tablespaces), while S-Designor was the only product to gather the View definitions.

Once our database had been reverse-engineered as a logical model, we began to modify the logical design. In view of the large number of entities involved, we first attempted to divide the entities into workable subsets of the enterprise model. Our test model, like most enterprise models, consisted of several smaller submodels, which represent business units such as accounting, manufacturing, and IS. These submodels were tied together through only a handful of common entities. We found that if a tool does not let you divide the model into workable submodels, the design becomes hopelessly unwieldy. The developer simply can't see the forest for the trees. ER/1 was the only product that did not support this feature.

In the next stage of testing, we began to refine our database model by adding entities, relationships, and primary- and foreign-key definitions. Parts of the original model had been intentionally created so that data integrity and relationships between tables were incomplete. We found that each product allowed us to perform the necessary modifications to the model, but with very different levels of ease. S-Designor proved the most intuitive, with ER/1 next, and ERwin pulling up the rear.

The first step in our refining process required us to change several primary keys and define several missing foreign keys. We then proceeded to add referential integrity and supply user-defined data types. We then attempted to apply our changes to the original physical database. Here, we found that only ERwin and S-Designor supported this functionality. ER/1 can generate a new schema from scratch, but it does not have a way of synchronizing an existing physical database with a changed logical model.

As an additional step, we tried to convert the Microsoft SQL Server database to both Oracle7 7.2 and Sybase SQL Anywhere formats. Although we found that all the products converted most of our database definitions, they all had problems when it came to converting the existing stored procedures and triggers. This was due to differences in language syntax, database functions, and system table formats. But we did find that all the products gave us a tremendous head start in the conversion process.

The final step in our evaluation involved generating reports about our database model for documentation. All of the tools offered basic reporting features.

ER DIAGRAMMING TOOLS AT A GLANCE

	ER/1 1.0	ERwin/ERX 2.5	S-Designor 4.2.1.0
List price	$1,399	$3,495	$3,495
Reverse-engineering database schema using a direct database connection	✔	✔	✔
Reverse-engineering database schema from a SQL DDL script file		✔	✔
Automatically generates triggers to enforce declarative referential integrity	✔	✔	✔
Multiuser data dictionary to store defaults, rules, and user-defined data types		✔	✔
Automatically generates 4GL application code		✔	✔
Supports division of entity-relationship diagrams into functional subdiagrams		✔	✔
Supports native database connections		✔	✔

PRODUCTS NOT REVIEWED

At least two other ER tools not covered by this review are worthy of mention. InTek Technologies' Vivid Clarity is a newcomer to the desktop CASE arena. Vivid Clarity lets you visually develop a database model and generate a schema for Sybase, Oracle, and ODBC databases. Its Object Gallery provides a repository for relevant specification files and documents, and it supports OLE 2 objects. Vivid Clarity can automatically import and export PowerBuilder extended attributes and store them within the Object Gallery. It can also generate PowerBuilder DataWindows.

Asymetrix Corp.'s InfoModeler 1.5 is a database design tool that provides complete ER diagram views but also allows nontechnical users to participate in the design process. While other products express entity relationships, business rules, and database content in a manner that is difficult for end users to understand, InfoModeler's FORML language uses an English-like vocabulary to let end users and system analysts collaborate in system design. We did not review InfoModeler, because it has not been upgraded in some time and lacked the core reverse-engineering features that were assumed by our test script. A new version, expected this summer, promises to bring this interesting tool up to date.

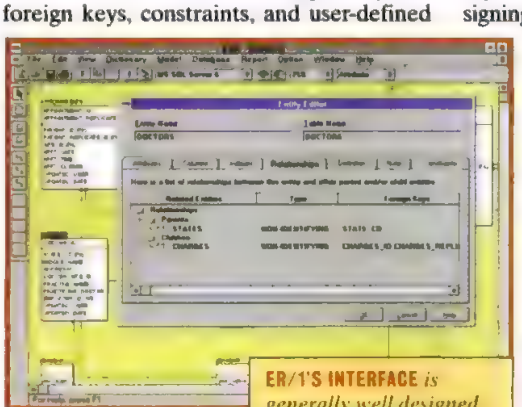
Embarcadero Technologies Inc.

ER/1

ALL REVIEWS BY BRIAN BUTLER

ER/1 1.0 is a new entry in the ER diagramming field from Embarcadero Technologies, better known for its SQL Ensemble Suite of client/server developer tools. We were generally impressed with ER/1's capabilities, especially considering that it is in its first release. In testing, ER/1's reverse-engineering capabilities were fully up to the task of generating our 120-table diagram. At the same time, it lacked some of the polish and amenities found in ERwin/ERX and S-Designor.

ER/1 supports ten different SQL databases through an ODBC connection. Unlike the other products in this roundup, it does not support reverse engineering through a data definition language (DDL) file but only through an ODBC database connection. ER/1 gives you reverse-engineering capability only on a new diagram; thus, you cannot easily merge several databases into a single diagram. ER/1 successfully reverse-engineered all of the major components of our test database, including tables and column definitions, primary and foreign keys, constraints, and user-defined data types. But it lacked the ability to retrieve triggers, stored procedures, storage attributes (segments, tablespaces), and definitions of Views.



ER/1'S INTERFACE *is generally well designed, but not all of the features we looked for are present in the product.*

ER/1 has four display modes to help you visualize the entity-relationship diagram: attribute, entity, primary key, and table. The attribute, entity, and primary-key displays show increasing levels of detail about the logical diagram, while the table display summarizes the physical database design. In contrast to ERwin and S-Designor, ER/1 will not let you divide the entity-relationship diagram into functional subdiagrams. This is an important omission if you are faced with any model of substantial size.

ER/1 is based on the IDEF1X methodology, one of the two methodologies supported by ERwin. Accordingly, diagrams in both products appear similar. Nonetheless, we found it substantially easier to perform data-modeling operations in ER/1 than in ERwin, thanks to the former's vastly superior user interface.

Our test script required us to modify some of the primary and foreign keys of our test database. Unlike S-Designor, ER/1 did not give us an easy method of changing a nonidentifying attribute to an identifying attribute. The workaround involved deleting the attribute and all of its associated indexes, then recreating the attribute as a primary key and reassigning the data type, defaults, and rules.

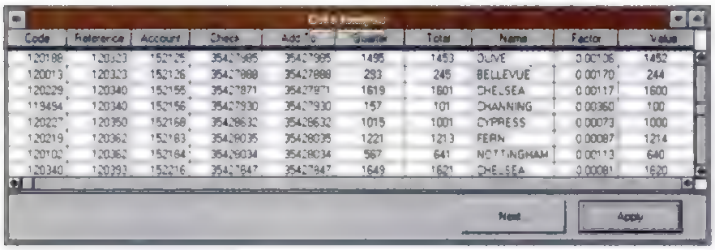
Following our script, we then further enhanced our model by defining several one-to-many and many-to-many relationships. We found ER/1's relationship-definition method was similar to those of all the other products we saw. You simply select the type of relationship, then drag the relationship line from the parent entity to the child entity. Double-clicking on the relationship line brings up a properties sheet.

ER/1 generated all the code needed for a database schema—including tables, indexes, triggers, and stored procedures—but it lacked the ability to modify our existing database. In order to apply our new logical model, our only option was to drop and recreate all the database entities, then bulk-copy the data in and out of all the tables. With both ERwin and S-Designor, we were able to alter only the modified tables.

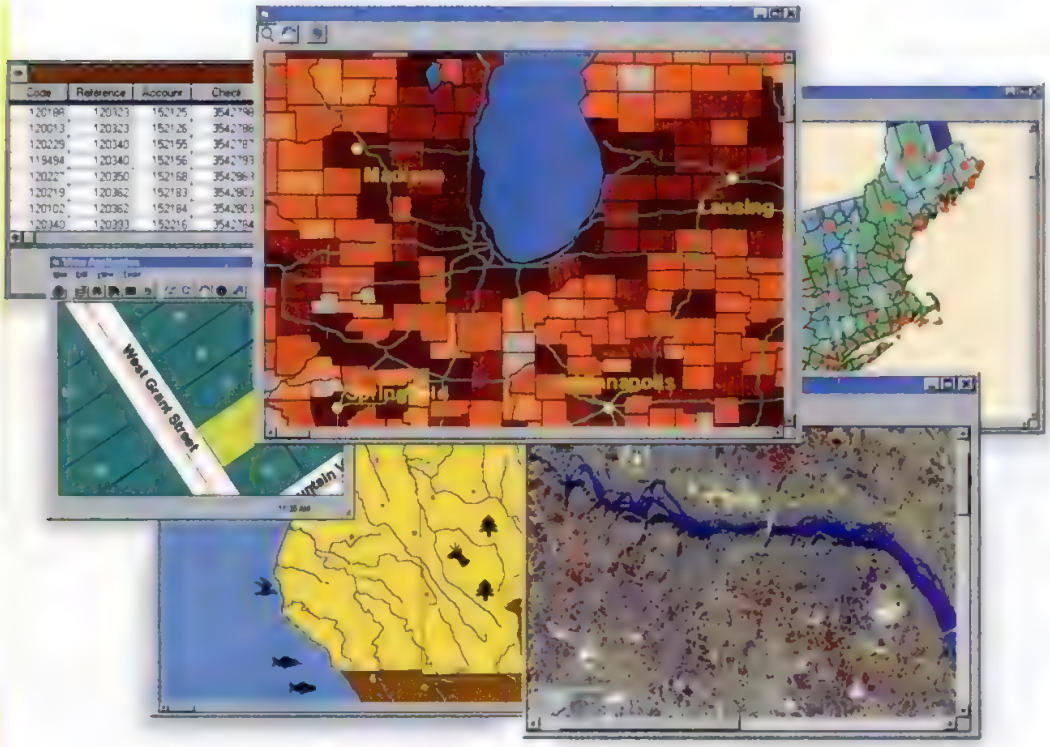
ER/1 gave us the basic tools to generate trigger code for enforcing referential integrity in the physical database. It uses templates to implement trigger code on the specified target. Templates are provided for Restrict, Cascade, and Set Null. You can't customize the base template specification to generate customized triggers, however—something you can do with ERwin and S-Designor.

While ER/1 does not provide a procedure editor, it does give you basic stored-procedure generation. The generated stored procedures can perform Insert, Update, Delete, and Select operations on tables based on primary-

This Is Your App...



This Is Your App with MapObjects...



With MapObjects, users can

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- **Display data using classifications, graduated symbols, labeling, dot density**
- **Display a variety of image formats**
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CIRCLE 240 ON READER SERVICE CARD

key definitions. In addition, ER/1 can create *shadow views,* views that simply mirror the structure of the underlying tables. Shadow views are useful for adding an extra layer of security.

You can generate ten different types of reports, including entity, attribute, relationship, and subtypes. We found reporting to be straightforward and simple. Unfortunately, the output was limited to simple columns stored in rich text format (RTF). You can optionally launch your RTF views after creation, but there is no method for creating a summary report of the entire data model in a single operation.

The ER/1 data dictionary stores defaults, rules, and user-defined data types that can be reused throughout the logical and physical design. The purpose of the data dictionary is to ensure consistency across both your logical and physical designs. Where defaults are used to ensure that table columns always have values, rules ensure that the values are valid. User-defined data types keep the columns' definitions uniform. Assigning data-dictionary objects to columns is performed in the Column Editor.

Currently, ER/1 does not support version control, and it was the only product in this roundup not to support check-in/check-out in a multiuser data dictionary.

Overall, we found ER/1 to be a strong first release that holds promise of becoming stronger. But for handling complex design challanges today, other tools offer greater power and flexibility.

ER/1 1.0. List price: $1,399. Embarcadero Technologies Inc., San Francisco, CA; 415-834-3131; fax, 415-434-1721; http://www.embarcadero.com/. *Circle 461 on reader service card.*

Logic Works Inc.

ERwin/ERX

For its balance of simplicity and power and its approachability for new users, Logic Works' ERwin/ERX has long been known as one of the best tools in its class. But as other ER tools have come on the scene, this 16-bit product is starting to show its age. Our evaluation of ERwin/ERX 2.5 showed it to be more than capable of handling our database modeling tasks, but its quirky interface made it less intuitive to use than other products.

We found ERwin's reverse-engineering (Logic Works' term is *synchronization*) features to be very capable but lacking in the polish we found in Powersoft's S-Designor. ERwin supports 13 different SQL databases, and it can reverse-engineer either through a direct database connection or from a SQL data definition language (DDL) file. In testing, ERwin's synchronization reverse-engineered all major database components (tables, primary keys, foreign keys, indexes, checks, options, triggers, and user-defined data types), as well as storage attributes (segments and tablespaces), but it lacked S-Designor's ability to retrieve the View definitions. ERwin was the only product in this roundup to support native database connections as well as ODBC.

ERwin displays all entities in the database in a single view, called the Main Subject Area. This view can be divided into smaller views of the logical model, called Specialized Subject Areas, which let you organize your model into specific business functions. Additionally, a subject area can contain multiple stored displays, each showing different levels of detail. You switch between subjects using a drop-down list box in the toolbar and switch between displays using tabs on the subject area window.

> Only ERwin has the ability to detect changes to the physical model and reflect them back into the logical model.

ERwin was the only product in our roundup to support two methodologies for developing entity-relationship (ER) models: the Integration Definition for Information Modeling (IDEF1X) methodology and the Information Engineering (IE) methodology. In contrast to S-Designor, both logical and physical models are developed using the same diagram.

Since our test database design was originally made with Microsoft SQL Server 4.2, we did not have all the primary keys defined. Thus, our first task was to clean up our database model and define the primary and foreign keys. We defined the relationships between two entities by selecting the type of relationship desired and then connecting them.

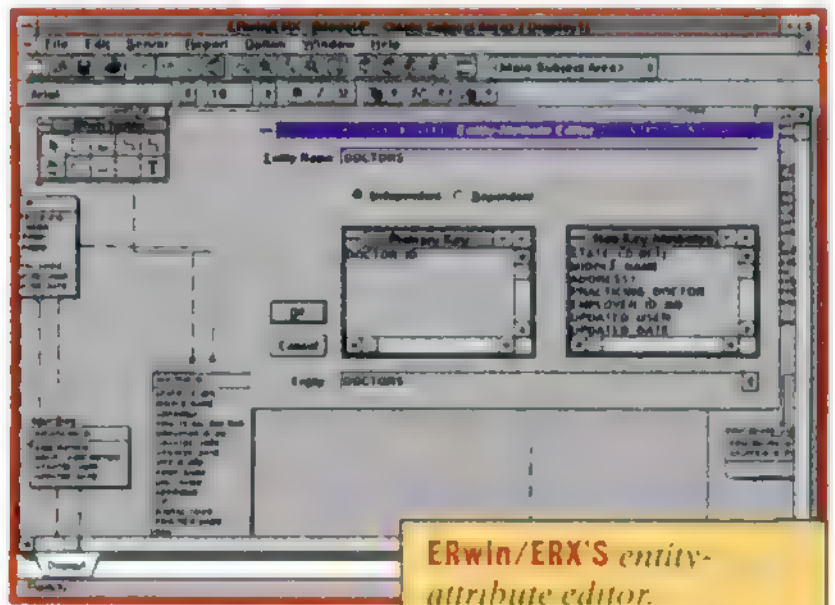
Depending on the feature set of your target database, ERwin can automatically create triggers, constraints, stored procedures, and user-defined data types. The implementation of triggers is particularly impressive. ERwin not only provides a default trigger collection to manage typical parent/child relationships, but it gives you the additional flexibility of a trigger template language. Since all the ERwin-generated triggers are based on templates, you can meet specific data-model requirements by customizing the templates. A stored procedure editor is also provided but does not offer much in the way of templates.

The most impressive feature was ERwin's two-way synchronization capability. While S-Designor can propagate changes from the logical model into the physical model, only ERwin has the ability to detect changes to the physical model and reflect those back into the logical model. For shops that strictly enforce data modeling, this feature is beside the point. But for those using simple database utilities like Microsoft SQL Enterprise Manager to modify the physical database directly, two-way synchronization provides a tool to straighten out all those outdated logical models.

The only hitch we encountered during the resynchronization of the logical model was an error message telling us that we could not add a column with Not Null as an attribute. The workaround involved backing up our data, manually selecting the affected tables, and issuing a Generate Schema with Drop command. This is a weak solution compared with S-Designor's method of automatically renaming the old table and copying the existing data into the new.

ERwin lets you generate five types of reports: entity, attribute, relationship, constraint, and subject area. You can name and save a group of report options for future use, a mercy considering the large number of options in the cluttered report dialog. We successfully turned out a number of dull-looking reports. Logic Works does offer RPTwin, an add-on banded report writer that helps dress things up.

ERwin supports a multiuser data dictionary, which can be stored in any of the 13 supported databases. Generating the data dictionary is as simple as opening an ERwin diagram and synchronizing it with your target database. At this point, you can check-in and check-out database models. Locking is provided at the model level. For more robust version control, ERwin supports links to Intersolv's PVCS.



ERwin/ERX'S *entity-attribute editor. Awkward interface features detract from this powerful product.*

ERwin biggest weakness is its quirky user interface, which lacks the amenities of context-sensitive help, a Select All Objects but-

ton, and a progress meter to monitor the reverse-engineering process. Although ERwin's core functionality rarely let us down, we were frequently dazed by its maze of cryptically labeled menu items and its screen controls, which didn't always follow standard Windows conventions. One particularly distracting feature was the floating edit control window, which paints itself before its parent dialog box appears, then jumps to the top of the parent dialog.

Overall, we were impressed by ERwin's features but somewhat less than enthusiastic about the way they are presented to the user. We hope that a new 32-bit version, due to be released this summer, will bring this powerful product fully up to date.

ERwin/ERX 2.5. List price: $3,495. Logic Works Inc., Princeton, NJ; 800-783-7946, 609-514-1177; fax, 609-514-1175; http://www.logicworks.com. *Circle 462 on reader service card.*

Powersoft

S-Designor

PC MAGAZINE EDITORS' CHOICE

S-Designor, a relatively new presence in the American market, is a mature, stable product that Powersoft acquired in April 1995 from a French firm and has since enhanced in several point releases. Our evaluation of S-Designor 4.2.1.0 found this tool powerful, intuitive, and easy to use.

S-Designor is not yet tightly integrated with Powersoft's well-known PowerBuilder, but it can generate PowerBuilder DataWindows directly from a logical model. This useful feature makes it possible to build prototype applications quickly, letting you verify that a given database model can support your business needs.

We caught S-Designor just months before the release of Version 5.0. This incremental upgrade will add new multiuser features and will be sold in a variety of new bundles, collectively known as the Designor Family of Products. S-Designor 5.0 should be available by the time this story appears.

S-Designor's most distinguished feature is its elegant separation of conceptual and physical models, in contrast to ER/1 and ERwin/ERX, which tend to blur the distinction by providing only a single data-model view. S-Designor divides the design subject into a Conceptual Data Model (CDM) and a closely coupled Physical Data Model (PDM). The CDM expresses the data model in terms of pure entity-attribute relations, forcing you to focus strictly on the logical aspects of the data model. The PDM expresses the model in database-specific terms, letting you concentrate on physical database design, performance, and specifics of the implementation.

We found S-Designor's reverse-engineering capabilities to be both robust and easy to use. We reverse-engineered our test database simply by choosing a source database (over 30 different databases are supported) and the reverse-engineering mode (either via SQL script or using an ODBC driver). Here, S-Designor has a slight edge over ER/1 and ERwin. Not only does it include support for tables, primary keys, and foreign keys, but it supports views as well.

With a click of a button, we produced a physical data model containing our database definitions. Using the Generate Conceptual Model option from the Dictionary menu, we then transformed our physical model into a conceptual model. S-Designor's submodel features let us isolate different subsystems of the enterprise model into smaller workable diagrams. Any changes in these submodels are reflected in the enterprise model.

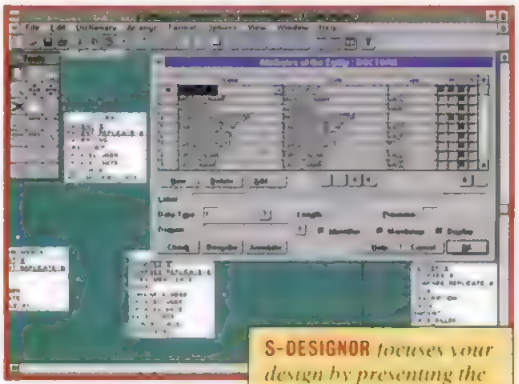
One thing that a new user might notice is the absence of foreign keys in the conceptual model. When defining entities in the conceptual model, you do not have to define attributes as foreign keys. You simply create an entity, then define the identifier, attributes, checks, rules, and relationships. The physical generation will automatically migrate the appropriate identifiers to foreign keys.

We successfully used S-Designor to generate a physical model for Microsoft SQL Server, Oracle7, and Sybase SQL Anywhere databases. During the conversion process, S-Designor mapped our entities to tables, attributes to columns, and identifiers to primary keys, while generating all needed constraints, foreign keys, triggers, and user types.

S-Designor's physical-model generation is more than a simple translation. The process intelligently converts logical relationships of the conceptual model to their physical-model counterparts. For example, our conceptual model had a many-to-many relationship between two entities. When we generated the physical model, S-Designor automatically created a third associative table, composed of the migrated identifiers as primary/foreign keys. In another case, our conceptual model had a table with a recursive relationship (an entity with a relationship to itself). The physical generation produced a table with an additional column (a foreign key) referencing its own primary key.

At this point, we were able to modify the physical database, adding indexes and graphics, renaming the generated foreign keys and the newly created associative table, and moving tables around in the diagram. We found the biggest advantage of the separation of conceptual and physical models was our ability to make implementation decisions, such as table denormalization, without adversely affecting the conceptual model. If you later change the conceptual model, you can preserve your physical model modifications with a check box in the physical model–generation dialog box.

When we wanted to refresh our existing test database with our newly refined database model, we found that we had to archive our original model, then modify the design to produce the appropriate DDL. The resulting DDL scripts were impressive. S-Designor performed a complete dependency check on the modified tables, then updated all the appropriate tables. In addition, S-Designor renamed the affected existing tables, created the newly modified tables, then copied the data from the original to the new. (S-Designor lacks a feature comparable to ERwin's two-way synchronization, however.)



S-DESIGNOR *focuses your design by presenting the conceptual data model in pure entity-attribute terms.*

S-Designor supports a multiuser data dictionary, which can be stored in the provided Sybase SQL Anywhere database or in any ODBC SQL database source. The data dictionary lets developers share objects such as entities through a check-in/check-out mechanism. A unique merge feature lets you combine multiple model files into a single model. But like the other tools in this roundup, S-Designor performs locking only at the model level rather than the object level, providing limited functionality for large, multiuser projects. Unlike ERwin, the current release does not support version control, although the upcoming 5.0 release will provide it through the new Object Cycle feature. The new release will also enhance check-in/check-out security and provide a browser for viewing objects across multiple projects and models.

Like the other tools in the review, S-Designor provides robust tools for generating and reverse-engineering databases. But its separation of conceptual and physical models encourages productive new ways of thinking about database design, while its well-thought-out interface makes it a pleasure to use. □

S-Designor 4.2.1.0. List price: $3,495. Powersoft, Concord, MA; 800-395-3525, 508-287-1500; fax, 508-369-3997; http://www.powersoft.com. *Circle 463 on reader service card.*

By Jeff Prosise

3-D Worlds on the Web

An introduction to Virtual Reality Modeling Language.

In roughly two short years, the World Wide Web has gone from being an obscure tool for scientists and engineers to a genuine cultural phenomenon. The Web is a series of hyperlinked documents created in Hypertext Markup Language (HTML). Without HTML, surfing the Web would be about as exciting as watching ice melt. It's HTML that allows any basement entrepreneur with a text editor to build colorful Web pages. And it's HTML that has transformed a subset of an obscure scripting language named SGML—short for Standard Generalized Markup Language—into a standard recognized around the world.

Today there's another scripting language emerging on the Web that has the potential to be just as important and every bit as pervasive as HTML. It's called *Virtual Reality Modeling Language*, or VRML. VRML is a language for building 3-D worlds on the Web. Imagine a Web page that looks and acts like a DOOM screen and you have a pretty good idea of what VRML is all about. A VRML document is a blueprint for a virtual world that you can walk around in using a VRML browser or a VRML extension to an HTML browser.

The Web is already populated with hundreds of VRML sites, and more are coming online every day. Figure 1 shows a sample VRML world. Soon you'll be able to log on to the Internet and stroll the streets of San Francisco, visit some of the world's most famous art museums, or walk through a virtual shopping mall—all because of VRML.

VRML solves the problem of the high bandwidth required to do real-time 3-D graphics over a network. A VRML browser downloads VRML files containing 3-D scene descriptions just as an HTML browser downloads HTML files containing page descriptions. The browser interprets the scene descriptions and renders the resulting images on the host computer. Rendering is performed through the lens of a virtual camera that moves, tilts, and twirls in response to user input. Imagine navigating your way around the Web not by clicking underlined words in HTML documents but by opening doors leading from room to room in a virtual building that represents Web cyberspace; clicking on objects will teleport you to other VRML sites.

The time is right for VRML, not only because of the interesting possibilities it presents for building next-generation user interfaces, but also because many PC and video card manufacturers are beginning to build inexpensive 3-D graphics accelerator chips into their hardware. Speed is the key to real-time 3-D graphics, and soon we'll all have it—in spades.

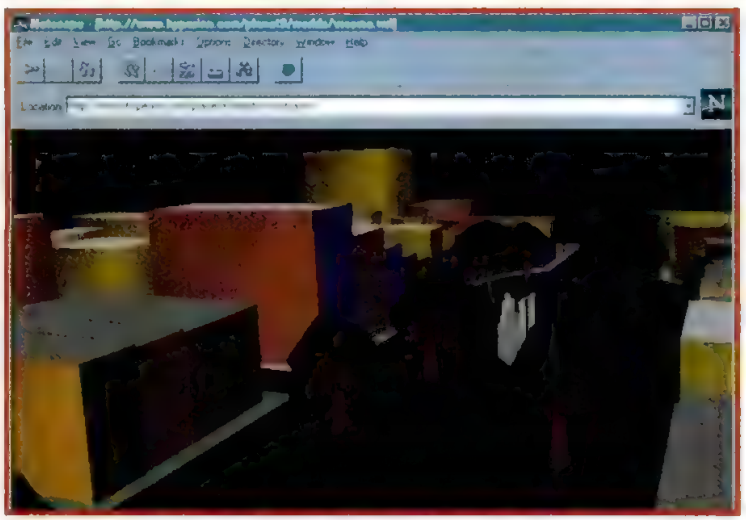


FIGURE 1: *This VRML world is called Virtual SOMA; it's a Web-based 3-D model of the San Francisco neighborhood where most VR development takes place. By clicking on a building, you can hyperlink to the home page of the company occupying the building. It's seen here through the WIRL Interactive VR Browser plug in for Netscape Navigator, which lets you navigate around the world using the mouse or the arrow buttons at the bottom of the screen.*

So what is this thing called VRML and how does it compare with HTML? Let's find out.

VRML PAST, PRESENT, AND FUTURE

VRML traces its origins to the first annual World Wide Web conference, held in Geneva, Switzerland, in March 1994. Tim Berners-Lee—father of the World Wide Web and one of HTML's creators—and David Raggett convened a session entitled "Virtual Reality Markup Languages and the World Wide Web" (the M in VRML was later changed to stand for "Modeling," but early on it stood for "Markup"). Attendees gathered to outline the basic requirements for a 3-D equivalent to HTML and formed an electronic mailing list of parties interested in hammering out a VRML specification.

A draft specification for VRML 1.0 was presented at the next World Wide Web conference, in October 1994. Rather than developing a 3-D scripting language from scratch, the specification's authors received the blessings of Silicon Graphics to borrow a subset of the text-based scene-description language used in the 3-D modeler named Open Inventor. That subset, which used human-readable commands such as "Cube" and "Cylinder" to represent 3-D objects, formed the core of the VRML 1.0 specification. The draft also included Web-specific commands for creating links to other VRML sites on the Web, just as HTML documents can include links to other documents. It did not include commands for creating dynamic VRML environments, primarily because its authors wanted to get Version 1.0 up and running as quickly as possible.

VRML 1.0 was officially introduced to the world in April 1995. A draft specification for Version 1.1 is currently available on the Internet, and comments are being solicited for Version 2.0. Version 1.1 will correct some of the deficiencies in Version 1.0 and add a few capabilities of its own, such as rudimentary sound and animation support. Version 2.0, whose features have been proposed in a Web document entitled "Moving Worlds," will transform VRML into a highly interactive multiuser environment in which objects define their own behavior and "participants" can see each other on the screen. You can view the various specifications and proposals for current and future versions of VRML at the following Web sites:

- Version 1.0: *http://vrml.wired.com/vrml.tech/crml10-3.html*

- Version 1.1: *http://vag.vrml.org/vrml1-1.html*
- Version 2.0: *http://webspace.sgi.com/moving-worlds/spec/spec.main.html*

THE VRML LANGUAGE

VRML is a scriptlike language whose documents are composed of plain ASCII text. By convention, VRML files are given the extension .WRL, which is short for "world." The very first line in every VRML file is the statement

```
#VRML V1.0 ascii
```

The leading pound sign indicates that a comment follows. The `VRML` identifies the file as a VRML file, `V1.0` identifies the VRML version number, and `ascii` identifies the file contents as ASCII text. When subsequent versions of VRML are introduced, the version number in line 1 will enable the browser to determine which version of VRML the .WRL file supports. Future versions of VRML are also likely to support non-ASCII character sets for the benefit of international users.

VRML documents, or *scene graphs* as they are commonly known, consist of "nodes" defining objects in the scene as well as properties of those objects—size, color, surface texture, and so on. The following VRML file combines three cubes to create a 3-D plus sign:

```
#VRML V1.0 ascii
Separator {
  Cube {
    width 8.0
  }
  Cube {
    height 8.0
  }
  Cube {
    depth 8.0
  }
}
```

`Separator` and `Cube` are two of the 36 node types defined in VRML 1.0 (see the table "VRML 1.0 Node Types"). Nodes that appear between the curly braces of a Separator node are grouped together. `Cube` draws a cube. The full syntax for the Cube node is

```
Cube {
  width 2.0
  height 2.0
  depth 2.0
}
```

`Width`, `height`, and `depth` are fields that define the node's attributes—in this case, the cube's dimensions in the *x*, *y*, and *z* directions. The width, height, and depth of a cube default to 2 units. Default values are used automatically for fields that aren't assigned values explicitly. For example, the statement

```
Cube {}
```

creates a "default" cube that measures 2 units in each direction.

In VRML, as in most 3-D graphics systems, drawing is performed in an *x-y-z* coordinate system. Cubes drawn by `Cube` are centered at the origin. To position one object beside another, you would draw the first object and then translate the coordinate system with a `Translation` node before drawing the second object. The following VRML file draws a 3-D plus sign and then draws a sphere below it by shifting the origin downward 10 units in the direction of the negative *y* axis:

```
#VRML V1.0 ascii
Separator {
  Cube {
    width 8.0
  }
  Cube {
    height 8.0
  }
  Cube {
    depth 8.0
  }
  #Start a new group
  Separator {
    Translation {
      translation 0.0 -10.0 0.0
    }
    Sphere {
      Radius 4.0
    }
  }
}
```

The coordinate system can also be rotated with `Rotation` nodes and scaled with `Scale` nodes. The `Transform` node allows the coordinate system to be translated, rotated, and scaled in one step, and the `MatrixTransform` node performs a transformation using a custom 4-by-4 transformation matrix.

Now suppose we'd like to add color to the objects in the previous examples. A `Material` node defines the properties of surfaces in a scene. `Material` has several optional fields, including `diffuseColor`, which specifies the color of the diffuse light that a surface reflects, and `shininess`, which specifies a surface's shine. We could make the 3-D plus sign bright yellow and the sphere shiny blue by modifying the file once more:

```
#VRML V1.0 ascii
 Separator {
   Material {
     diffuseColor 0.9 0.9 0.0
   }
Cube {
  width 8.0
}
Cube {
  height 8.0
}
Cube {
  depth 8.0
}
#Start a new group
Separator {
  Translation {
    translation 0.0 -10.0 0.0
  }
  Material {
    diffuseColor 0.0 0.0 1.0
    shininess 1.0
  }
  Sphere {
    Radius 4.0
  }
 }
}
```

The values in a `diffuseColor` field specify red, green, and blue color components. The numbers 0.0 0.0 0.0 corresponds to black, and 1.0 1.0 1.0 corresponds to bright white. A shininess value of 1.0 creates a highly reflective surface.

To create even more realistic-looking scenes, you can use texture nodes to paint textured surfaces—surfaces that look like brick walls, wood, or marble, for example. VRML 1.1 will probably support "animated" textures, which can be used to simulate TV screens, among other things. LOD (level of detail) nodes allow VRML worlds to be rendered in varying levels of detail depending on the distance between the observer and the objects in the scene. One use for LOD nodes is to conserve CPU cycles (and improve performance) by displaying textures only when they're close enough to be seen.

The powerful `WWWInline` node allows scenes to be imported from other VRML files. The *WWW* in the node name is a reference to the World Wide Web. A `WWWInline` node can retrieve VRML files from a local hard disk or from a remote site on the Web. Not surprisingly, remote files are identified by URL addresses. `WWWAnchor` creates a live link to another VRML world; it's the VRML equivalent of an anchor tag in HTML. We could make the 3-D plus sign a link to the VRML Repository at the University of California's San Diego Supercomputer Center by modifying our sample file one more time:

```
#VRML V1.0 ascii
Separator {
  WWWAnchor {
    name "http://www.sdsc.edu/vrml"
    description "VRML Repository at
  ➥SCSD"
```

```
    Material {
      diffuseColor 0.9 0.9 0.0
    }
    Cube {
      width 8.0
    }
    Cube {
      height 8.0
    }
    Cube {
      depth 8.0
    }
  #Start a new group
  Separator {
    Translation {
      translation 0.0 -10.0 0.0
    }
    Material {
      diffuseColor 0.0 0.0 1.0
      shininess 1.0
    }
    Sphere {
      Radius 4.0
    }
  }
}
```

The `WWWAnchor name` field holds a URL, and the `description` field contains a text string describing the link. Many browsers display the description string when the pointer is over an anchor. `WWWInline` and `WWWAnchor` nodes can also reference non-VRML resources such as HTML and .GIF files, although browsers may vary as to exactly how they handle non-VRML resources.

As you can probably imagine, this simple example barely scratches the surface of what you can do with VRML. Scanning the node names in the table on this page will give you an idea of where we could go with this example if we were to continue. VRML 1.0 is a powerful scene-description language that encapsulates many of the concepts central to modern 3-D computer graphics, from basic polygonized objects to shading, lighting, and texturing. A number of VRML modelers are already available for systems running Windows 95 and Windows NT, and more are on the horizon. It's not practical to build large VRML models by hand, but it's instructive to build a simple one line by line to learn how VRML works.

VRML 1.0 NODE TYPES

Node name	Description
Shape nodes	
Cone	Draws a cone.
Cube	Draws a cube.
Cylinder	Draws a cylinder.
Sphere	Draws a sphere.
Point, line, and face nodes	
Coordinate3	Defines 3-D coordinates for points, lines, and faces.
IndexedFaceSet	Draws a shape using faces defined by a set of points.
IndexedLineSet	Draws a shape using lines defined by a set of points.
PointSet	Draws a shape using a set of points.
Text nodes	
AsciiText	Draws a string of ASCII text.
FontStyle	Controls the typeface, style, and size of text drawn with AsciiText.
Material nodes	
Material	Defines surface-material properties.
MaterialBinding	Binds surface materials to shapes.
Normal	Defines 3-D normal vectors for shading.
NormalBinding	Binds normal vectors to shapes.
ShapeHints	Specifies vertex ordering, face types, and other properties that affect rendering.
Texture nodes	
Texture2	Defines a texture image.
Texture2Transform	Applies a 2-D texture-mapping transform.
TextureCoordinate2	Defines 2-D texture-mapping coordinates.
Transformation nodes	
MatrixTransform	Performs a transform using a custom transformation matrix.
Rotation	Rotates the coordinate system.
Scale	Scales subsequently drawn shapes.
Transform	Translates, rotates, and scales in one step.
Translation	Moves (translates) the coordinate system.
Camera nodes	
OrthographicCamera	Creates a camera that renders scenes using orthographic projection.
PerspectiveCamera	Creates a camera that renders scenes using perspective projection.
Lighting nodes	
DirectionalLight	Creates a directional light that casts parallel light rays.
PointLight	Creates a point light source that radiates light in all directions.
SpotLight	Creates a spotlight that radiates light in a cone, like a flashlight.
Grouping nodes	
Group	Defines a group of nodes.
Separator	Defines a group of nodes and restores all scene properties after the group is drawn.
Switch	Defines a group of nodes and draws only one member of the group.
TransformSeparator	Defines a group of nodes and restores selected scene properties after the group is drawn.
Anchor and in-line nodes	
WWWAnchor	Creates a link to another VRML file.
WWWInline	Imports a scene from another VRML file.
Miscellaneous nodes	
Info	Creates a node containing nondisplayable information such as copyrights.
LOD	Specifies varying levels of detail for rendering objects located at different distances from the eye.

VRML RESOURCES

Where can you go if you'd like to learn more about VRML? Start off by looking at the Web itself. Your first destination should be the VRML Repository maintained by the San Diego Supercomputer Center (*http://www.sdsc.edu/vrml*). The Repository contains dozens of helpful VRML resources, including links to VRML documentation and specifications, a VRML FAQ, and links to sites from which you can download VRML browsers and modelers.

After you've scanned the Repository, check out the VRML standards site (*http://www.vrml.org*). Among other things, you'll find links to popular VRML sites and a VRML "test page" containing sample VRML files. Another site containing useful VRML information is *http://www.lightside.com/3dsite/cgi/VRML-index.html*.

I've read or at least skimmed through many of the available books on VRML and can heartily recommend two of them. The best and most comprehensive VRML book to date is *The VRML Sourcebook* (1996, John Wiley & Sons), by Andrea L. Ames, David R. Nadeau, and John L. Moreland of the San Diego Supercomputer Center. This book is highly readable, covers virtually every aspect of VRML 1.0, and does a commendable job of explaining the theory underlying transformations, shading, texture mapping, and other tenets of 3-D graphics. It contains numerous examples and is packed with illustrations. If you buy only one book on VRML and your primary interest is learning the ins and outs of the language, this is the one to get.

Another book that I found helpful in getting acquainted with VRML is Mark Pesce's *VRML—Browsing and Building Cyberspace* (1995, New Riders Publishing). While not as detailed as *The VRML Sourcebook*, it contains interesting historical insights into the development of the language (Pesce is one of the creators of VRML), a useful tutorial, and a handy reference. It also comes with a CD containing VRML browsers, software for building and viewing VRML worlds, an HTML version of the VRML 1.0 specification, and other tools to get you quickly up to speed on VRML. □

Jeff Prosise is a contributing editor of PC Magazine. *His new book,* Programming Windows 95 With MFC, *is scheduled to be published soon by Microsoft Press.*

By Barry Simon

The Windows 95 Exchange Inbox

Learn how to tap the power of Windows 95's e-mail client.

Included with Windows 95 is a powerful, universal e-mail client called Exchange Inbox. Remarkably, the printed documentation for this program is only one sentence long. What's more, the online help fails to cover a number of the program's features. This results in user complaints about things like Exchange's inability to save the address in a message to an address book. Actually, this feature does exist, but not only is it unintuitive, it is completely undocumented.

My goal in this article is to cite some of the main features of Exchange Inbox I've found through considerable experimentation with the program and some consultation with Microsoft. Several of its features, especially the search capabilities, are extremely useful. Although the user interface isn't awful (it's miles beyond Lotus Notes Mail), it is often disorienting. This is especially true if you're used to the Windows 95 Shell, because Inbox looks and acts much like Explorer—though with many subtle differences.

MAPI

Underlying Exchange Inbox is MAPI, Microsoft's Mail Application Programming Interface (Figure 1). MAPI serves as the glue between five kinds of objects: Message Stores, Address Books, Service Providers, MAPI-aware applications, and the MAPI client.

Message Stores are files of OLE objects, the most obvious example of which is an e-mail message. But you can also use message stores to store any file with an OLE header. Information about the file from the OLE header will be displayed in the object list on the right side of an Exchange Inbox window.

The *Address Book* specification is quite extensive, allowing the addition of service provider–specific fields to the address entries.

Service Providers supply the back end for MAPI—the links a MAPI client calls to send and collect mail. Don't confuse this use of the term with Internet service providers (ISPs), companies that offer Internet access.

MAPI-aware applications call the MAPI client mostly via a Send item on the File menu. If you install Microsoft Fax, for example, you get a printer named Microsoft Fax, which, despite its name, is just a call to the MAPI client. (It can be used to send e-mail as well as faxes.) So through Microsoft Fax any program can gain some degree of MAPI awareness.

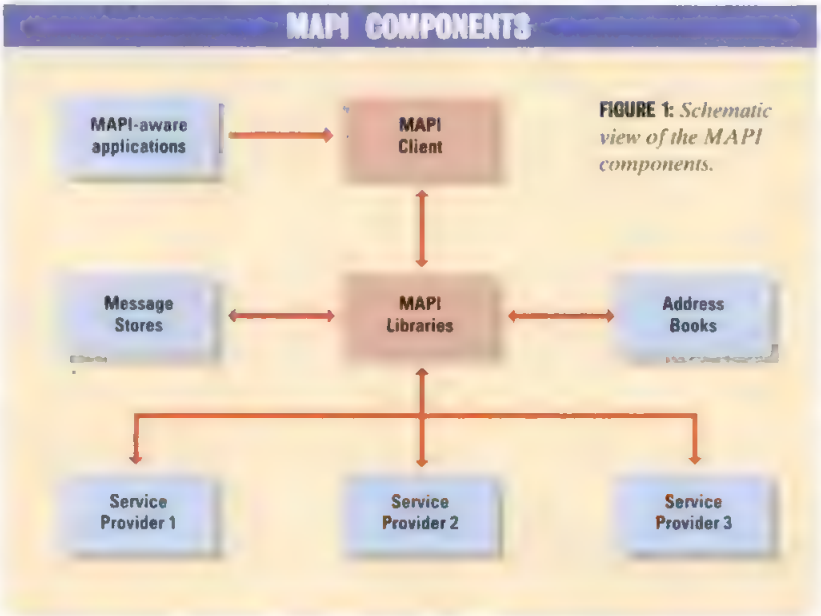


FIGURE 1: *Schematic view of the MAPI components.*

As the roles of the other MAPI players suggest, the central object is the *MAPI client* (the Exchange Inbox itself). The MAPI client is responsible for letting the user interact with the Message Stores, the Address Books, and the Service Providers.

MAPI UNDER WINDOWS 95

Windows 95 includes three sets of programs to implement MAPI: a variety of Service Providers, the Mail and Fax applets in the Control Panel for putting the components together, and the Exchange Inbox, which acts as a front end to access your address book and your message stores.

Three providers are built into the Windows setup and can be installed either during the initial setup or later, through the Add/Remove programs applet: Fax, The Microsoft Network (MSN), and Microsoft Mail. On the Windows CD, in the directory \drivers\other\exchange\compusrv, is a CompuServe provider (you can download an update from CompuServe in the Windows Connectivity forum, GO WINCON). An Internet Mail module for Internet providers using SMTP/POP3 mail servers comes with Microsoft Plus! This module is also in the Internet Explorer file that you can download from Microsoft's Web site.

Microsoft Exchange Server, an enterprise-wide information manager/mail system currently in beta, will include an enhanced MAPI client. To avoid confusion, Microsoft suggests calling this enhanced module the Exchange Client and calling the MAPI client that ships with Windows the Exchange Inbox.

MAPI is an open spec, so we can expect alternate MAPI clients to emerge soon. Delrina's WinFax PRO ships with a full-fledged MAPI client that can read and use the same message stores and address books that Exchange Inbox does. And although it will not include a full-fledged client, QualComm's Eudora Pro will have a module that intercepts MAPI calls by MAPI-aware applications and routes them to the Eudora e-mail program.

EDITORS

Exchange Inbox comes with a decent text editor for composing and reading messages. It produces rich-text-format documents (for now, only MSN and some Internet systems support RTF) with OLE-embedded documents. It will perform spell-checking if you have Microsoft Office 95 installed.

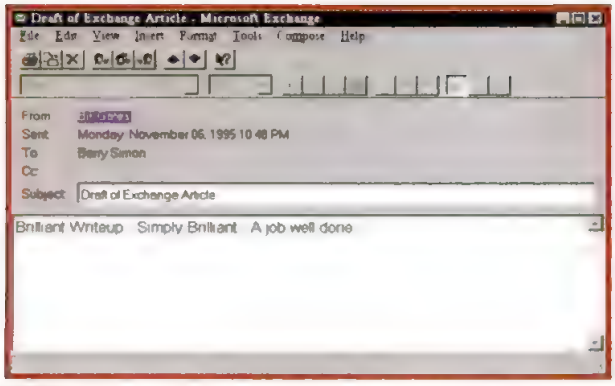


FIGURE 2: *Although it's black text on a gray background, you can select this Address Object, which has properties (double-click to see them) and a Context menu (right-click).*

Then again, if you do have Microsoft Office 95, you can install Microsoft Word itself as your e-mail editor. This mode of Word, called WordMail, is an installation option during Office Setup. Once it's installed, you can switch between editors using the WordMail Options... choice on the Compose menu in Exchange Inbox.

WordMail gives you a number of Word's wonderful features, such as keyboard macros, highlighting, on-the-fly spell-checking, AutoCorrect, and AutoText. But there are also some features of the Exchange Editor that have not been carried over: There is no longer an Insert Message menu item; you'll need to use copy and paste instead. Nor is there a button to add an address to your address book from a displayed *Address Object* (discussed below); you'll have to use the Context menu of the address object.

All things considered, however, if you have Microsoft Office 95, you'll probably want to use WordMail.

ADDRESSING SHORTCUTS

While composing a message, you can call up an address book by pressing the To: or cc: buttons, but another method is often quicker: If you type in a partial name and hit the Check Names button, the editor will check the address book. If there is a unique match, it is entered. If there are multiple matches, a list is presented from which you can choose.

You can even enter multiple partial names or partial addresses, separated by semicolons, in the To: and cc: fields, hit the check button, and resolve each name in succession.

If you hit the Send button with unresolved names, the editor will try resolve them at that point.

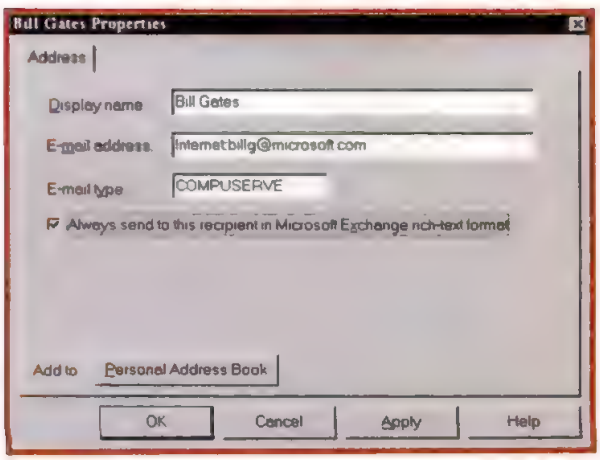


FIGURE 3: *The properties of an Address Object. Note the Add to Personal Address Book button.*

ADDRESS OBJECTS

Look at the header portion of an incoming message in the Inbox Editor (the part that contains the To: and From: information). Because it is black text on a gray background, you may think of it as static and dead, but it isn't. Select a name from those fields and double-click on it (Figure 2). If a name isn't recognized as being from your address book, you'll get a panel notifying you, as shown in Figure 3.

Some address objects are tokens of address book entries: When you double-click, you get the full, tabbed address-book dialog for the name. Other address objects have only three fields: display name, e-mail address, and e-mail type.

Notice that Figure 3 also shows a button labeled "Add to Personal Address Book." That's one way to add someone to your personal address book when you get a message from them—simply double-click on the name, then click this button.

If you are using WordMail in place of the Inbox editor, the Add to Personal Address Book button will be absent, but there is another way to add to the address book. With either editor, there is a context menu that includes an entry called "Add to Personal Address Book" (Figure 4). You get this menu by right-clicking on the address object.

Address objects also occur in messages that you compose—underlined names in the To: and cc: boxes. For example, if you reply to a message from someone not in your address book, his or her name will appear underlined in the Reply. Double-click on such a name and you'll get the same three-field panel that you get for an address object on an incoming message.

Address objects have properties typical of other objects in Windows 95. Not only is there a context menu, you can also drag and drop address objects or copy them to the clipboard and later paste them.

As a simple example of how the ability to drag and drop address objects is useful, consider what happens when you hit the Reply to All button in an incoming message. The names of the sender and all people in the To: section of the initial message are placed in the reply's To: field, and the cc: names from the initial message go in the reply's cc: field. What do you do if you want the To: field to have only the name of the initial sender and you want all the other names in the cc: field? Simple! Just click on the address objects in the To: field that you'd like in the cc: field and drag them there.

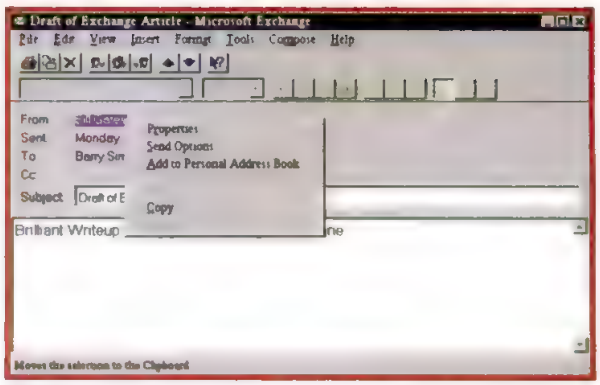


FIGURE 4: *This Context menu for Address Objects is available by right-clicking. Note the command Add to Personal Address Book.*

It's also possible to drag and drop an address object from an incoming message to an outgoing one. If you hold down the Ctrl key while you use the mouse, you can click on several address objects and drag them all at once. (If you do that, the address objects may appear without semicolons between them. But that's no problem—sending the message or clicking the check button will automatically insert the missing semicolons.)

YOUR OWN ADDRESS OBJECTS

If you want to send a message to someone without adding his or her name to your address book, you can drag and drop or copy and paste—as long as the name appears in some incoming message. But suppose you have an address of someone written on a piece of paper or written out inside a message to you, and you want to e-mail that person without placing his or her name in your address book.

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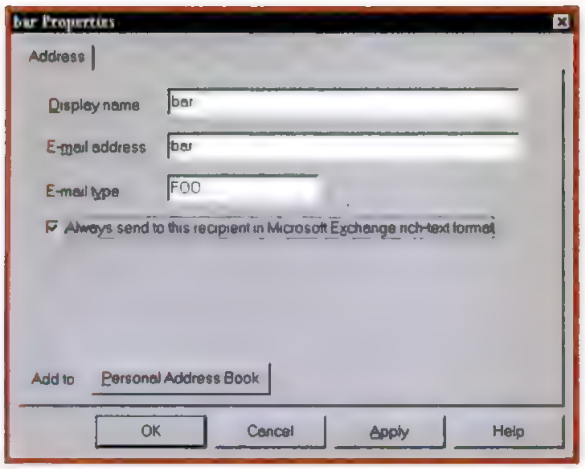

FIGURE 5: *The properties of the object you create by typing [foo:bar] in the To: box and hitting the check button.*

You can create your own address objects using one of two syntaxes. The first, using "[ ]" and ":", is generic, and the second, using "@" and a ".", is specific to Internet addresses. To understand the first, hit the compose button, type [foo:bar] into the To: box, and hit the check button. Magically, [foo:bar] is replaced by bar with an underline.

If you double-click on the new address object, you'll find the fields have been set with the e-mail type set to "FOO" and the name and address fields set to "bar" (Figure 5). From this dialog, you can edit any of the three fields.

Of course, you wouldn't want to make an address object with a nonsense type like FOO, but you can use this method with the proper mail types:

CompuServe	COMPUSERVE
Fax	FAX
Internet	SMTP
The Microsoft Network	MSN

For example, to send a one-time fax to the number 800-123-4567, you'd type in [fax:1-800-123-4567] and hit the check button. If you wanted to change the display name, you could double-click to edit it.

If you use a nonsensical e-mail type or misspell a valid one, the editor will let you "send" the message but at some point you will get a message from the System Administrator telling you that there is no valid service provider given. If the invalid address is the only one, this happens immediately. If there are both valid and invalid addresses, the complaint only comes after the message has been sent off to the valid addresses. In either event, the original message is placed in your Sent Mail folder—a strange convention if there are only invalid addresses.

INTERNET ADDRESSES

Besides the [TYPE:address] syntax for creating address objects, there's a second special syntax that understands Internet addresses. To be recognized by Inbox, an Internet address must include the @ symbol and must include a period in the portion following the @ symbol (for example, billg@microsoft.com). When you hit the check button, it becomes an address object with type SMTP, the appropriate type for Internet mail.

SMTP is a valid type for both direct Internet Mail and MSN but not CompuServe. To get CompuServe to recognize such an address object, you need to change the type to COMPUSERVE and add "internet:" in front of the address.

As with address-book checking, you do not need to hit the check button after entering a totally valid address in either of these formats—when you hit the send button (or pick Send from the File menu), the address objects are created.

MULTIPLE INTERNET MAIL PROVIDERS

There is a potential problem with Internet mail. If you've installed MSN, you will have difficulty if you subsequently install the Internet Mail Provider. The symptom of the problem is that when you connect to your Internet provider, you'll be able to receive Internet mail, but any Internet mail you have set to send will remain in your out-box.

You can see the cause of this problem—as well as its solution—by calling up the Options dialog from the Tools menu in Exchange and looking at the Delivery tab. The lower part of that Tab has a list labeled, "Recipient addresses are processed by these information services in the following order" (Figure 6). What that means is that when an e-mail type is understood by multiple services, it is processed by the one that is highest on the list. Both MSN and your Internet provider understand SMTP, the Internet e-mail type, so to send Internet mail via your Internet service provider, you need to be sure that Internet Mail appears higher on this list than MSN. Just highlight it and use the arrows to the right of the list to move it up.

ORDER OF SERVICE PROVIDERS

Under the Tools Menu are two submenus that let you choose which service to send and collect mail from: Deliver Now Using and Remote Mail. You may wonder how Exchange decides the order in which the services appear there. Remarkably enough, it uses the list in the Tools/Options/Delivery tab I just discussed. The order of services on the submenus is the exact opposite of the list of services in the Delivery tab. By adjusting the order on that list with the aforementioned arrows, you can control the ordering of the services in the Deliver Now Using submenu.

PROFILES AND MULTIPLE MESSAGE STORES

The Mail and Fax applet of Control Panel lets you add and remove service providers and message stores kept in a profile. You can use the Show Profiles button in that applet to set up multiple profiles for Exchange.

Multiple profiles are useful if a machine has multiple users. Profiles can use the same message store, so, for one service, portable computer users can create multiple profiles that differ only in their access phone numbers. Profiles also make it easy to use multiple accounts on a single service. You can only have one instance of the service provider, but each profile can include a different account number for that service provider. On a system with multiple active profiles, you can configure Exchange to prompt for the profile to be used each time it starts.

Although you can have only one instance of each service provider, a profile can have multiple message stores and use Exchange Inbox to copy or move messages between different stores. This is useful for moving messages to an archival store and for transferring messages collected on a portable to your desktop message store.

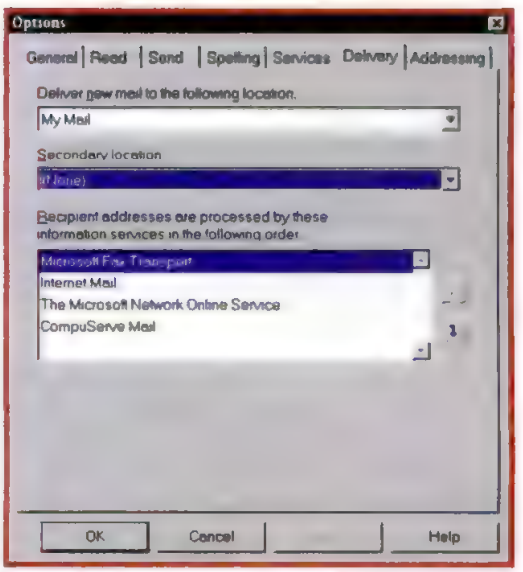

FIGURE 6: *The Delivery tab of the Tools/Options dialog in Exchange Inbox.*

All in all, Exchange Inbox is a powerful, intriguing program—once you take the time to learn its ins and outs. □

Barry Simon is a contributing editor of PC Magazine.

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How Business Does Business On The Internet.

CIRCLE 070 ON READER SERVICE CARD

By Brian Proffit

InterNotes: More than Just a Browser

Lotus's solution for connecting business with the Internet.

We continue to be driven by the need for information. Users' hunger for more, better, and faster access to information is matched by IS departments' thirst for easier acquisition, storage, and distribution of that information. Lotus Development Corp. has addressed these needs with InterNotes, one of the most significant enhancements included in Release 4.0 of Lotus Notes.

InterNotes is a transparent coupling between Notes and the Internet. The heart of this coupling is the InterNotes Server, which performs the dual functions of retrieving information from the Internet and converting that information into Notes database format. That database is then available to any Notes client, just like any other database.

FIGURE 1: *The InterNotes Web Navigator looks like any normal database in the workspace.*

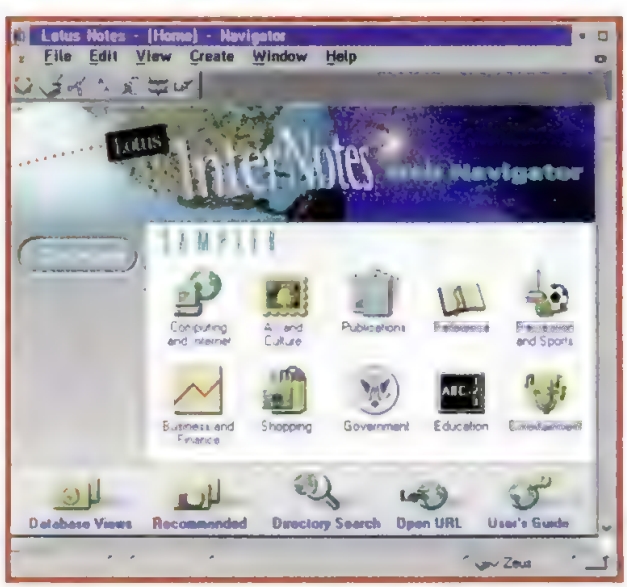

FIGURE 2: *Web Navigator provides an interface to Internet resources.*

HOW DOES IT WORK?

The portion exposed to end users is the InterNotes Web Navigator. As you can see in Figure 1, the Web Navigator looks like any other Notes database on the desktop. The difference is that a shortcut into that database has been added to the SmartIcon bar at the top of the window. Clicking on the hand pointing at a globe lets you immediately enter a URL you would like to load.

When you open the Web Navigator database, you see an interface unlike that of any other browser (Figure 2)—because, of course, you're not really looking at a browser, you're looking at a Notes database. When you ask for a Web page, the request goes to the InterNotes Server. If that page already exists on the server, it is sent directly in Notes document format. If not, the server loads the page from the Internet. The page is converted from HTML format into Notes document format before you ever see it, with all the graphics and hypertext links maintained. And, as Figure 3 illustrates, the Notes document that is generated and the native Web page are indistinguishable.

This conversion does have a side effect, though: Since you won't see any of the document until the entire page has been converted to Notes format, you don't see the graphics as they are painted and you can't begin scanning the text before the graphics download is complete. The more graphically complex the page, the more annoying that delay can be.

The graphical support is good, and it includes support for pages with fill-out elements like text boxes. InterNotes supports only HTML 2.0, though, and doesn't include such enhancements as frames, tiled background images, blinking text, background sounds, and marquee scrolling. Both interlaced and noninterlaced .GIF types are supported as well as plain JPEG, but not Progressive JPEG. Multimedia extensions aren't supported, either. Unsupported graphics are replaced by the familiar icon you see when waiting for a graphic to load, while unsupported text features simply appear as plain text in the Notes version of the page. Table support is included, though it's rather rudimentary, using line-drawing characters instead of graphics.

Lotus promises continued support of evolving Web page enhancements—including Netscape extensions and the developing VRML standard. But some of this support may prove difficult, as it requires upgrading the capabilities of Notes documents. Since helper apps don't work, at least not with this release, that means updating the basic Notes document architecture. It isn't likely to happen soon.

Web Navigator doesn't limit you to Web pages. In addition to HTTP, it supports downloading from FTP and Gopher sites and embedding HTTP, FTP, Gopher, and mailto links within Notes documents for easy, single-click access. Web Navigator also supports authenticated sites, providing an automatic dialog box that prompts for ID and password before allowing access to those sites.

TIME AND SPACE

In large companies, dozens of users may need access to the same information. If that information comes from the Internet, each user normally needs to attach to the Internet and download the pages—a massive duplication of time and effort that can strain external communications links and hinder productivity. Storing the information on multiple desktops is a further duplication that wastes resources. But the alternative—reloading the same pages again and again—is hardly satisfactory.

InterNotes neatly resolves the dilemma by providing a single server to contain the necessary pages. When a user requests a page, it can frequently be loaded from the server (at network speeds), thus avoiding an Internet con-

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CIRCLE 023 ON READER SERVICE CARD

From News to Notes

Access to Usenet newsgroups is not an integral part of the Notes 4.0 Web Navigator, but Lotus provides a solution in the form of a separate product. InterNotes News, originally developed and released by IRIS Associates, acts as an interface between Notes and Usenet.

Using the Network News Transfer Protocol (NNTP), InterNotes News runs on the InterNotes server and converts Usenet data into Notes documents. Users can browse newsgroups and send replies from their local systems without directly accessing the Internet. Through SMTP mail connections, users can also send replies to the authors of news items via e-mail.

Users have the advantage of being able to view news items using the familiar Notes discussion database, with its hierarchical view of threads, full text search, and macro capabilities. And administrators can make Usenet information available across the enterprise without the need for TCP/IP on each desktop, while maintaining centralized control over newsgroup subscriptions and access.

nection and download. The InterNotes Server administrator can keep the Web database current using a new feature of Notes 4.0—*agents*, which are similar in concept to macros and provide significant power.

One type of agent included with the Web Navigator database is a refresh agent designed to access the Internet periodically and reload new copies of frequently changing pages. By default, the agent runs daily at midnight, checking the date last modified on each document against the current date. If the dates don't match, the agent retrieves the last modification date in the HTTP header from the Internet server. If the page has been updated since last retrieved, the agent downloads the latest version of the page, converts it to Notes document format, and updates the document in the database.

Agents can also assist in controlling the size

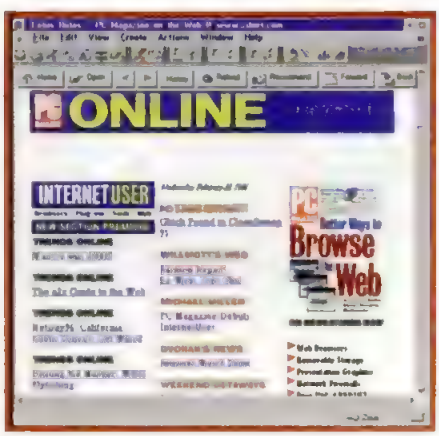

FIGURE 3: *The Notes document is indistinguishable from the original Web page.*

of the Web Navigator database. Not only can you set a firm upper limit on database size, but a purge agent included with Web Navigator can traverse the database each night, selectively removing pages based on criteria you define. For example, you can instruct the purge agent to remove automatically any documents whose pages no longer exist on the Internet or to remove documents after a specified number of days. And you can optimize space by automatically purging documents larger than a specified size (the default is 256K). Users can thus download large pages as needed, without regard for long-term storage considerations. You can even specify whether the purge agent should check private folders that users may have created and purge documents from them as well.

NEW POSSIBILITIES

Time and resource savings aren't the only reasons to use InterNotes' Web Navigator. One of Notes' nice features is its ability to do full-text searches through Notes databases. Since InterNotes stores Web pages as Notes documents, you can do full-text searches through Internet data as well. You also gain the ability to browse quickly through available Web pages using Notes 4.0's window panes, shown in Figure 4. In fact, once you stop thinking of Web Navigator as a Web browser and start thinking of it as a Notes database, many new possibilities unfold. You can forward Web pages to other Notes users, and you can cut and paste from Web pages into other documents or into e-mail.

For more sophisticated manipulation, there are new @functions and LotusScript methods available for processing Web data. Developers can use @URLGetHeader to retrieve the HTTP header information, @URLHistory for maintaining and traversing history lists, and @URLOpen for retrieving specific pages. There are also three new LotusScript methods designed for the Internet. OpenURLDb returns a pointer to the Web Navigator database, GetDocumentByURL retrieves a page as a Notes document, and GetURLHeaderInfo retrieves the HTTP header for a page.

Internet hot links can be embedded into other Notes documents. Thus you can send an e-mail suggesting that the recipient take a look at a Web site, and the address you include in the message can be a hot link directly to that location. In fact, you can create customized Web tours that will guide others through a series of pages you find interesting. This is a great way, say, to bring employees up to speed on the competition. You can even create recommendation databases by grouping Web sites within the categories shown in Figure 2 and giving them a rating from poor to excellent (1-5). Then, a user looking for an Internet resource on computing, for example, can see exactly which Web sites have received the highest ratings in that area.

And you're not limited to the folders provided with Web Navigator. You can create your own folders for storing Web documents in ways that are meaningful to you, and a private bookmark folder gives you quick access to documents you refer to most frequently.

GETTING THE INFORMATION OUT

Today organizations are not only interested in acquiring and disseminating to employees the information located on a variety of Web sites. They are equally attracted to the idea of creating their own Web sites, complete with company and contact information, product lines, development efforts, and so forth. But creating and managing an enterprise Web server is no small feat, often requiring the input of many departments and individuals, few of whom are likely to be Web experts. Enter InterNotes Web Publisher, a Notes server program that builds on Notes' existing document-management system to provide an automated method for creating and managing a Web site.

InterNotes Web Publisher lets you take Notes documents from disparate users and convert them automatically into HTML for-

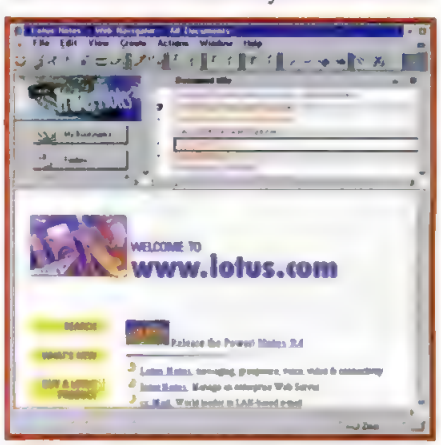

FIGURE 4: *You can quickly browse stored pages for the desired information.*

mat. Thus, for example, Notes documents become HTML files, Notes forms become HTML forms, and Notes doclinks become hypertext links. Those skilled at creating Notes documents can make good use of this facility. It

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should be noted, however, that for now the functions you can put in your pages are restricted to the HTML 2.0 specification, as indicated above. Web Publisher will also create a home page for your database using the About Database document; the database views appear as hypertext links on the home page.

It doesn't take much of a leap to grasp the possibilities inherent in the Internet and the flexible HTML format for distributing information within an organization as well, and many companies are heading in this direction. And it's an equally modest jump to the realization that the same Web Publisher facilities that let you publish company information online make it easy to construct an intranet for sharing internal information.

SECURITY

Since the InterNotes Server is the only machine on the system that directly accesses the Internet, it is the only one required to run TCP/IP. Not incidentally, this centralized server gives the administrator security control over access to Web pages. The administrator can allow or deny access to any Internet site by name or IP address. Wildcards are supported, making it easy to restrict users to specific sites: You can deny access to *www.*.com* while permitting, for example, visits to *www.pcmag.com*. The tighter security that's derived from a single point of contact with the Internet extends to the enterprise as well. You can place the InterNotes server behind a firewall proxy server to prevent intrusion.

ADDING IT UP

In companies looking for tight control over Internet access and document storage, InterNotes may indeed become the product of choice. With Web Navigator, retrieving static pages and sharing Internet information with others is as easy as handling any other information in Notes, and Web Publisher does the same for putting out the information. Both suffer from the HTML limitations noted above, however. And if you're in a real hurry for a page you're not likely to need again, you may well prefer a browser that doesn't force you to wait through the intermediate step of converting from HTML to Notes document format. Also, Web sites are already beginning to make heavy use of advanced HTML functions and enhancements not yet available in Web Navigator.

Lotus avows a commitment to enhance InterNotes so that it meets and keeps pace with the capabilities of other browsers and Web publishing tools. The key will be whether it can respond sufficiently with upgrades as enhancements like animation, multimedia, and Java applets become more widespread. □

Brain Proffit is a senior contributing editor of OS/2 Magazine *and author of* OS/2 Warp Survival Kit.

By John Lam

A New Way to Open Windows 95 Files

This shell extension creates multiple file associations.

One of the most useful features of Windows 95 is also one of its most painfully limited features. If you double-click on a filename in Explorer, Windows will open that file using the file's associated application—if an association already exists. Otherwise, Windows will show you its Open With... dialog box and ask you to associate an application with the extension of the file you just double-clicked on.

I use this feature all the time to open .TXT files in Notepad (the default association). But what if I wanted to open the same .TXT files in Microsoft Word? This is the painful part. I would have to open Microsoft Word, select File Open, and use the dialog box to find the file that I was already looking at in Explorer! And I thought Windows 95 was supposed to make my life easier! But now it can.

This issue's utility, MultiLaunch, lets you associate more than one application with a file extension. It is a Windows 95 shell extension that you access through a file's context menu—the menu that pops up when you right-click on its icon. MultiLaunch adds a section to the context menu that lists programs you can use to load the document. Figure 1 shows three new items in the context menu of BOOTLOG.TXT: Notepad, Write, and WinWord. Click on any of these three menu items and you will open the file using that application.

You can obtain MultiLaunch by downloading it from PC Magazine Online or by mail. Refer to the sidebar "Guide to Our Utilities" for details. The source code for MultiLaunch, which was written in Microsoft Visual C++ 4.0, is also available for download for those interested in seeing how it works.

USING MULTILAUNCH

Since MultiLaunch is a shell extension, it is in the form of a dynamic link library rather than an executable and must be "registered" in the Windows 95 Registry. The MultiLaunch setup program contains the DLL in compressed form and does the registration for you. When you run MULTIL.EXE, the installation program asks you where you want to install the MultiLaunch DLL (MLAUNCH.DLL). The default location is your Windows System directory, but you can store the DLL anywhere you like. Select the location, click OK and you're ready to run.

To add multiple file associations for a given file type, right-click on a file icon of that type and select the Properties menu item at the bottom of the context menu. This will bring up the Properties dialog box. In addition to the ubiquitous General tab, which provides you with information about the file size, the date it was created, and some of its attributes, you will see a MultiLaunch tab. Click on this tab to bring up the MultiLaunch association page.

Figure 2 shows the MultiLaunch association page for BOOTLOG.TXT with the associations for Notepad, Write, and Word already added. As with the standard double-click functionality, the associations apply to any filename with this extension. Therefore, all .TXT files on which you right-click will have these three new menu items in their context menus.

IN THIS ISSUE

MultiLaunch

MultiLaunch lets you associate more than one application with any document file type. It is a Windows 95 shell extension that you access through a file's context menu—the menu that pops up when you right-click on its icon.

You can use the Add and Delete buttons to add and remove applications that are associated with this file type. Click the Add button and you will get a standard Windows 95 Open dialog box that you can use to browse for applications. When you are done making associations, click OK and you're ready to launch.

If you ever want to remove MultiLaunch from your system, you should use the Unregister MultiLaunch utility that comes with MultiLaunch (UNREGML.EXE). This will safely remove all the MultiLaunch keys from your Registry. After running UNREGML.EXE, you must reboot Windows 95 before you can delete the MLAUNCH.DLL file.

INSIDE MULTILAUNCH

While Microsoft has provided some very nice enhancements to the Windows 95 user interface "out of the box," the most useful thing the company did was to allow developers to *extend* the Windows 95 user interface. Developers can add the following types of Windows 95 user interface extensions, otherwise known as shell extensions:

- Context-menu handlers add menu items to a file's context menu.
- Drag-and-drop handlers enable drag-and-drop notifications from the Windows 95 shell.
- Icon handlers provide icons for a file shown in Explorer.
- Property-sheet handlers add pages to a file's property-sheet dialog box.
- Copy-hook handlers enable notifications when a file is about to be copied, moved, deleted, or renamed.

MultiLaunch is both a context-menu handler and a property-page handler. A shell extension must be registered in the Windows 95 Registry before it can be activated. MultiLaunch adds several new entries. We'll begin our discussion by taking a look at how information is stored in the Registry.

THE WINDOWS 95 REGISTRY

The Windows 95 Registry is a hierarchical database of information about your system. Its structure is analogous to the structure of directories and files on your hard disk. A registry *key* is analogous to a directory, and a registry *value* is analogous to a file. Just like a file, a registry value has a name and some information contained within it: the registry data. Also, a registry key can contain other keys, just as a directory can contain other directories.

Windows 95 provides a tool called RegEdit (short for Registry Editor) for viewing and changing the Registry. Named REGEDIT.EXE, it can be found in your Windows directory. An icon for this program is not installed on your desktop when you install Windows 95, because the program can be dangerous to

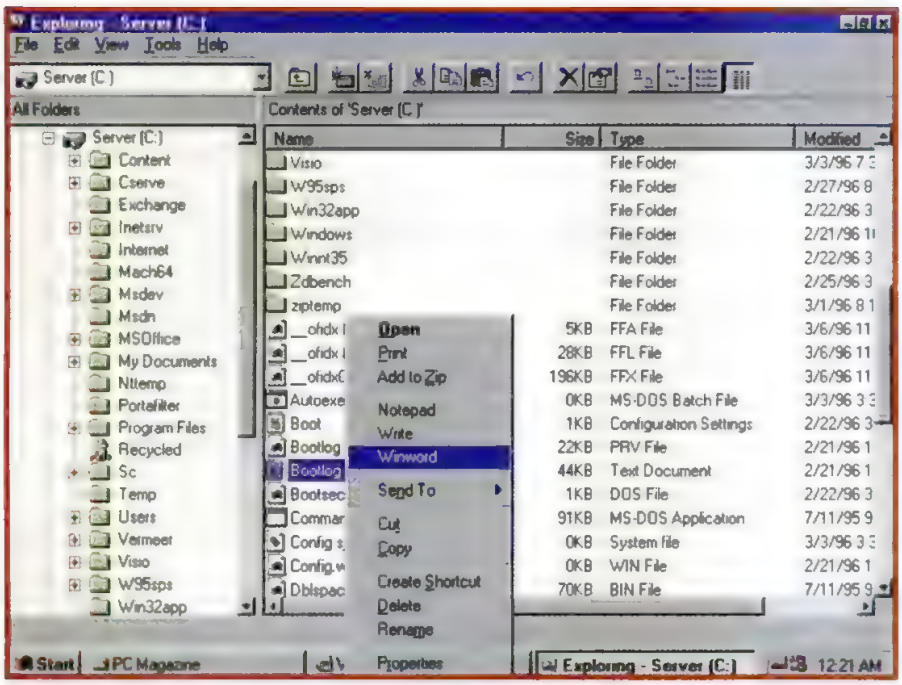

FIGURE 1: *With MultiLaunch installed, the context menu contains three new items: Notepad, Write, and WinWord. Click on any of these to open the file using that application.*

use—*make no changes to the Registry unless you know exactly what you are doing.*

When you first launch RegEdit, you'll see the top-level view of the Registry. In the left-hand pane are the top-level Registry keys; the right-hand pane displays the value for the currently highlighted key. The six main branches of the Registry you see displayed on the left are:

- HKEY_CLASSES_ROOT, which points to a branch of HKEY_LOCAL_MACHINE that holds essential user interface information such as OLE and association mappings.
- HKEY_CURRENT_USER, which points to a branch of HKEY_USERS for the currently logged in user.
- HKEY_LOCAL_MACHINE, which stores hardware and software settings for the machine itself.
- HKEY_USERS, which contains setup and configuration information for all users who log on to the computer.
- HKEY_CURRENT_CONFIG, which points to a branch of HKEY_LOCAL_MACHINE and holds information about the current configuration of the hardware.
- HKEY_DYN_DATA, which contains dynamic Plug and Play information.

Windows 95 shell extensions are implemented as OLE objects, so the first step in registering MultiLaunch is to register it as an OLE object. The HKEY_CLASSES_ROOT branch of the Registry is the place for this registration. To register an OLE object, you need a GUID (globally unique identifier), a 128-bit number that uniquely identifies the object. Developers can obtain unique GUIDs directly from Microsoft or by running a GUID-generating utility. Microsoft VC++ ships with a utility called GUIDGEN.EXE that I used to obtain the identifier. When the GUID is converted into string form, it is called a CLSID (Class ID). MultiLaunch's CLSID is 3D61D3C2-7036-11CF-B097-C080C7410B7E.

The key that registers MultiLaunch as an OLE object is shown in Figure 3. The full hierarchy isn't visible in the window, but the current registry key is

```
\MyComputer\HKEY_CLASSES_ROOT\CLSID\
➥{3D61D3C2-7036-11CF-B097-C080C7410B7E}
```

The key that defines MultiLaunch as an OLE object has this CLSID as its name and a description of MultiLaunch's purpose as its default value (displayed in the right-hand pane). It also has two subkeys: InProcServer32 and ProgID. One value of the InProcServer32 key identifies the location of the .DLL that contains MultiLaunch. The other specifies that MultiLaunch uses a programming style called the "Apartment threading model." This programming style is common to all OLE objects. The ProgID subkey has as its default value a human-readable programmatic ID for MultiLaunch.

Once the MultiLaunch OLE object is registered with the system, two more keys must be inserted to register it as a context-menu handler and as a property-sheet handler. Figure 4 shows the context-menu entry. It consists of a subkey added to the ContextMenuHandlers key. The name of the subkey is MultiLaunch.1, which is the programmatic ID of the MultiLaunch object. And the key's default value is the CLSID string for MultiLaunch. Before Windows 95 displays a file's context menu, it checks the subkeys of the ContextMenuHandlers key. Each subkey provides the CLSID of the corresponding object, and Windows 95 checks the entry in HKEY_CLASSES_ROOT\CLSID that matches this CLSID to get the location of the .DLL that implements the object. A similar entry under the PropertySheetHandlers key makes MultiLaunch available as a property-sheet handler.

Next we need to establish a connection between a particular file extension and one or more associated programs via MultiLaunch. The Windows 95 Registry contains keys for filename extensions that have been registered by applications or by the user. These keys are found directly under HKEY_CLASSES_ROOT, and they all begin with a period. MultiLaunch stores its associations for a file extension below the extension's key in a subkey named MultiLaunch. The names for this key's values get added to the context menu; the data string corresponding to each value is the full pathname of the program to be launched.

Figure 5 shows how MultiLaunch stores associations in the MultiLaunch subkey of the .TXT key. When a user interacts with MultiLaunch's Property Page to add a new association, MultiLaunch will create a new registry value under the MultiLaunch subkey for that filename extension. If the extension did not already have a file association, MultiLaunch will create the extension key as well.

MultiLaunch needs to enumerate the values of a Registry key under several different circumstances. To handle this efficiently, I created a helper class called CRegistryKey that, upon initialization, reads a given key's values into a handy linked list. When you construct an instance of CRegistryKey, you pass its constructor a valid registry key. CRegistryKey

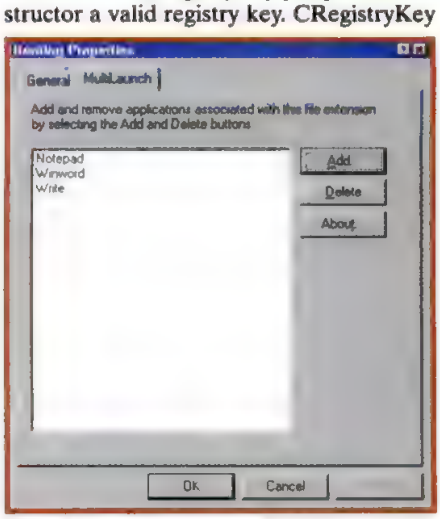

FIGURE 2: *Shown here is the MultiLaunch association page for BOOTLOG.TXT, with the associations for Notepad, Write, and WinWord already added.*

enumerates all of the registry values under this key and stores them internally using MFC's CObList linked list object. For each registry value that CRegistryKey enumerates, it constructs a new CRegistryValue object on the heap and initializes it to the registry value's name and the registry value's data.

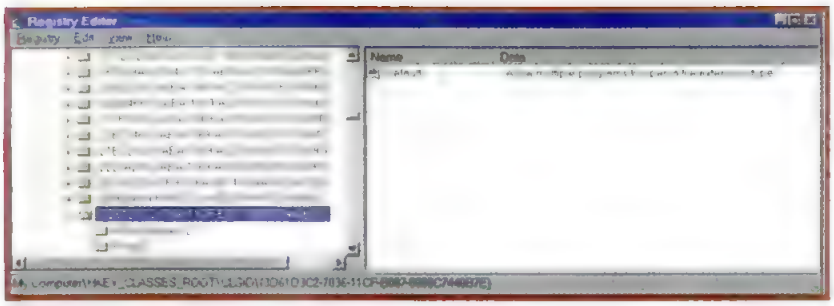

FIGURE 3: *This key registers MultiLaunch as an OLE object.*

When you wish to enumerate the registry values stored in CRegistryKey, you simply call CRegistryKey::GetNext to obtain a pointer to each CRegistryValue object. If you examine the functions CShellExtension :: QueryContextMenu, CShellExtension::InvokeCommand, and CML Page::OnInitDialog, you can see CRegistryKey in action.

WINDOWS 95 SHELL EXTENSIONS

When Microsoft released Windows 3.1, it popularized the term OLE (Object Linking and Embedding) to describe the interprocess communication standard that lets you store one document inside another. In Windows 95, OLE is implemented by way of a lower-level standard called COM (Component Object Model). The terms *OLE interface* and *COM interface* are often used interchangeably, but COM interface is more accurate and is the term I will use here.

Windows 95 uses COM to communicate with its shell extensions; all shell extensions are COM objects. Basically, COM defines a set of *interfaces*, or standard ways for objects to communicate with each other. Every COM object includes the basic interface IUnknown, which includes among its features a method for querying the object about any other interfaces it may provide. Each interface has an associated v-table (virtual function table) that holds the addresses of the methods for this interface. Implementation of these methods is the responsibility of the developer creating the COM object.

Windows 95 uses several COM interfaces to communicate with shell extension COM objects. MultiLaunch implements three of them: IShellExtInit, IContextMenu, and IShellPropSheetExt. The first, IShellExtInit, must be exposed by all property-sheet, context-menu, and drag-drop handlers. IShellExtInit has a single method, Initialize, which is called by the Windows 95 shell to initialize the handler. For property-sheet and context-menu handlers, the Initialize method receives a list of selected files. If this list includes more than one file, MultiLaunch cancels the initialization.

The IContextMenu interface must be exposed by all context-menu handlers, and MultiLaunch is a context-menu handler. As required, MultiLaunch implements the three methods specific to an IContextMenu interface: QueryContextMenu, InvokeCommand, and GetCommandString. The QueryContextMenu function is called by the Windows 95 shell when the user right-clicks on a file. MultiLaunch initializes the context-menu in this function. The InvokeCommand function is called when the user clicks on a menu item that was created by the QueryContextMenu

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function. The GetCommandString can be used to provide a help string for each menu item, among other things. However, an IContextMenu interface is permitted to implement GetCommandString as a do-nothing method, and that's what MultiLaunch does.

The remaining COM interface that MultiLaunch implements is related to its role as a property-sheet handler. The IShellPropSheet interface defines two methods: AddPages and ReplacePage. AddPages is called by the Windows 95 shell to add one or more pages to the property sheet. MultiLaunch creates and adds just one property-sheet page. ReplacePage is used only for control-panel object properties, so MultiLaunch implements it simply to return an error code.

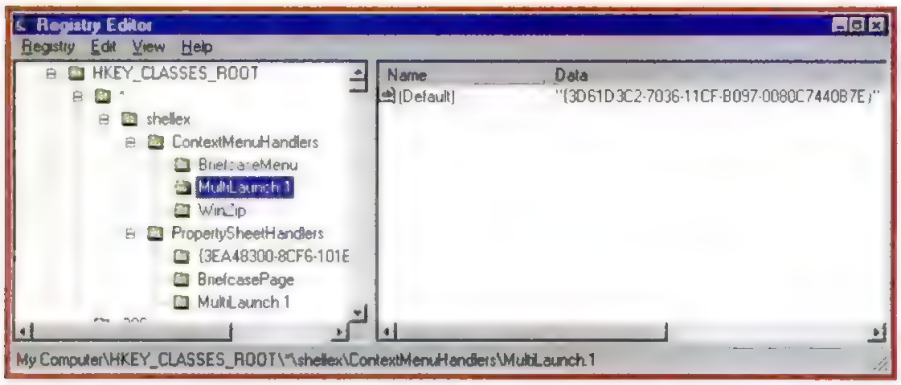

FIGURE 4: *The key highlighted here registers MultiLaunch as a Windows 95 shell extension.*

LAUNCHING AN ASSOCIATED APPLICATION

Next we'll look at how these interfaces enable MultiLaunch to perform its job. When a user right-clicks on a file, the Windows 95 shell checks the Registry for context-menu handlers and creates an instance of each one that it finds, including MultiLaunch. Windows 95 loads MLAUNCH.DLL into memory and calls the function DllGetClassObject, which must be exported by every DLL that implements one or more COM objects.

Windows 95 passes MultiLaunch's Class ID as a parameter to this function to indicate which object it wants. DllGetClassObject then creates an instance of a MultiLaunch class called CClassFactory. All COM objects need an associated "class factory" to construct additional instances of themselves. Once Windows has a pointer to the CClassFactory object, it can call the object's CreateInstance method to create any number of MultiLaunch objects.

Immediately after creating the MultiLaunch object, Windows calls the Initialize method of its IShellExtInit interface. If the list of selected files passed to this method contains more than a single file, MultiLaunch returns a failure code. Otherwise it stores the passed filename.

You might be thinking: How can there be several MultiLaunch objects present in memory at one time? This can happen if a user right-clicks on a file and brings up MultiLaunch's property page for that file, and then right-clicks on *another file* and brings up its MultiLaunch property page. In this case, two MultiLaunch objects would be present in memory at one time.

The activity initiated by right-clicking on a file continues with the creation of the context menu for that file. Windows 95 calls the QueryContextMenu method of the IContextMenu interface of MultiLaunch when it creates a new context menu. When it is dispatching commands that the user selects from the menu, it calls the InvokeCommand method of that interface.

All the interface methods described above are defined in MultiLaunch's source code as methods of a single object type, CShellExtension. CShellExtension is defined by MultiLaunch as multiply inheriting from the three standard COM objects IShellExtInit, IContextMenu, and IShellPropSheetExt. The member function CShellExtension::QueryContextMenu handles menu creation, and CShellExtension::InvokeCommand handles dispatching of commands from the context menu.

Both these methods create a new instance of a CRegistryKey object on the stack, passing it the registry key for the filename that the user has selected. Remember, CRegistryKey is a helper object defined within MultiLaunch to handle enumerating Registry keys. The QueryContextMenu method looks up the MultiLaunch key associated with the selected file's extension and adds the association subkeys it finds to the context menu.

When the Windows 95 shell calls InvokeCommand, it passes the command ID, which is a 0-based index into the context-menu items created earlier by QueryContextMenu. InvokeCommand looks up the registry value in the CRegistryKey object using the GetAt member function that returns a pointer to a CRegistryValue object. The m_strValue member variable of CRegistryValue contains the path to the application, and m_strFilename contains the filename selected by the user. InvokeCommand then simply calls WinExec to launch the application:

```
strCommandLine = pRegistryValue-
➡>m_strValue + " " + strFilename;
WinExec(strCommandLine,
➡SW_SHOWDEFAULT);
```

A SLICK WAY TO IMPLEMENT COM

MultiLaunch is an MFC application, but it doesn't use the standard MFC method of implementing COM interfaces for one simple reason—they're clumsy! As explained earlier, a MultiLaunch object is really a CShellExtension object. CShellExtension must therefore implement the three COM interfaces supported by MultiLaunch: IShellExtInit, IContextMenu and IShellPropSheetExt. The way this is handled in MFC is by creating nested classes under CShellExtension that each contain v-tables for the interfaces. Since MultiLaunch's data is contained in the parent class, much tedious code must be written to maintain the parent/child relationship properly.

I used a different approach in MultiLaunch. Instead of creating nested classes within CShellExtension, I used the multiple inheritance feature of C++ to obtain access to all three interfaces within the CShellExtension class itself. Multiple inheritance in C++ lets you override the implementation in an ancestor but still call the implementation in the ancestor call if you choose. The class declaration for CShellExtension is

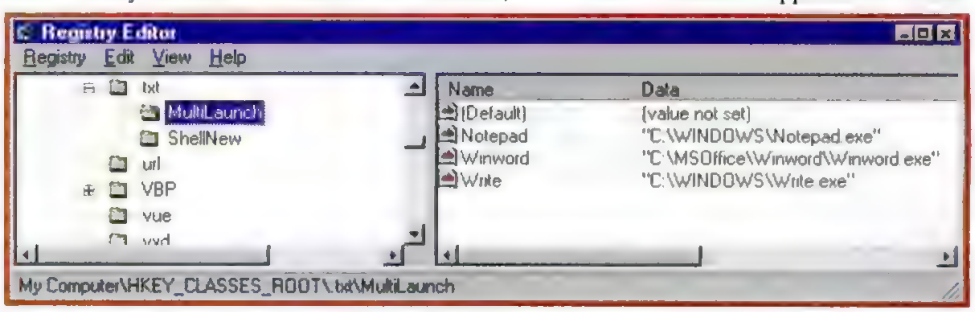

FIGURE 5: *MultiLaunch stores associations in a MultiLaunch subkey under the relevant file extension key. When a user adds a new association, it adds a new Registry value for that subkey.*

```
class CShellExtension : public
➥IShellPropSheetExt, IShellExtInit,
➥IContextMenu
```

With this elegant solution, I can use one v-table for all three interfaces simply by using a typecast. When you typecast a pointer to CShellExtension into one of its ancestor classes, C++ creates a v-table that is compatible with that ancestor class and populates it. In essence, multiple inheritance creates a v-table union, and casting populates the shared v-table with the appropriate set of methods. I simply typecast the implicit C++ `this` pointer into one of CShellExtension's base classes when I need to create one of those interfaces!

You can see this in action by looking at the implementation of CShellExtension::QueryInterface function (see Figure 6). Through the typecasting trick mentioned in the previous paragraph, QueryInterface elegantly exports all four of the interfaces supported by MultiLaunch. This is a much cleaner implementation than the MFC solution, which requires using nested classes.

MFC AND WINDOWS 95 SHELL EXTENSIONS

One of my goals for this utility was to show how you can use MFC to create a Windows 95 shell extension. While the existence of MultiLaunch shows that it is certainly possible to do so, it wasn't quite that easy to create the first time! In particular, getting CPropertyPage to work correctly was the source of a lot of grief.

CPropertyPage is an MFC-derived class that handles all the user interface interaction required by the MultiLaunch property page. It contains the code that adds and deletes registry entries for MultiLaunch associations. CPropertyPage was designed to work in conjunction with CPropertySheet, the MFC class that handles the Properties dialog box. CPropertyPage knows how to communicate and share data with CPropertySheet—an MFC-created property sheet—but if you want it to communicate with a non-MFC property sheet, such as one that is created by the Windows 95 shell, you have to pass it the necessary information

The standard Windows API method of communicating this information is to use DialogProcs and fill in many convoluted WIN32 API structures. This method works fine but it's tedious, so I wanted to try to implement it using MFC. I had problems, however. To discover how to make it work, I had to delve deep into the mechanics of how MFC handles property pages.

THE TOP 10 UTILITIES

1. **STRING** Batch file enhancer
2. **WARPCA** OS/2 file cabinet
3. **APPOIN** Windows appointment book
4. **ZDROP** Drag-and-drop unzipping
5. **FDDLLS** Finds dead DLLs
6. **SPAD** Enhanced Windows Notepad
7. **WINBAR** Taskbar for Windows 3.1
8. **INCTR2** Monitors program installation
9. **WMATCH** Compares directory contents
10. **1MBF** Protects low memory

When you create a CPropertyPage object, the actual window that is the Property Page has not yet been created. But MFC needs to know the value of the window handle for the property-page window. This is because MFC uses a single DialogProc called AfxDlgProc to handle message dispatching to all MFC-created dialog boxes. AfxDlgProc does a dynamic lookup using the hWnd of the window's message to obtain a pointer to the CDialog-derived object that is supposed to handle the message. To get the window handle of a window that doesn't yet exist, MFC sets a CBT (Computer-Based Training) hook that sends notification messages to MFC every time a window is created on the system. In the handler for the CBT hook, MFC checks to see if the window created is an MFC window, and if so, it informs the CDialog-derived object of its window handle when the window is created.

To create a property page, Windows 95 uses a PROPSHEETPAGE structure. There is a pointer to a DialogProc in the PROPSHEETPAGE structure and also a pointer to a callback function that receives notifications from Windows when the property page is actually created or destroyed. MFC uses the callback function to set a CBT hook to watch for the creation of the property-page window. To know which CPropertyPage object's window is being created, MFC uses the PROPSHEETPAGE lParam member variable to store a pointer to the CPropertyPage object that "owns" that property page. When Windows calls the property page callback function, it passes it a pointer to the PROPSHEETPAGE structure for the property sheet being created or destroyed. By looking at the PROPSHEETPAGE lParam member variable, MFC can find the CPropertyPage object that owns that property page.

When I reached this point in my investigations, I found the first bug that was preventing my code from working. Unfortunately, I happened also to be using lParam to store a pointer to the filename that the user clicked on in Explorer. Whoops!

I also found one additional twist. When Windows destroys the property sheet object that it created, it also destroys all of its associated property pages. However, Windows doesn't tell the CPropertyPage object to destroy itself. That's my job. Surprise! If I didn't do this, I would have a memory leak. To perform this task, I hook into the property page callback function and wait for the notification message PSPCB_RELEASE. When I receive this message, I look up the pointer to my CPropertyPage object in the PROPSHEETPAGE lParam member variable and use this pointer to destroy it. This is

```
STDMETHODIMP CShellExtension::QueryInterface (REFIID riid,
➥LPVOID* ppvObj)
{
    *ppvObj = NULL;
    HRESULT hr = E_NOINTERFACE;

    if (riid == IID_IUnknown) {
        *ppvObj = (LPUNKNOWN) (LPSHELLPROPSHEETEXT) this;
        hr = NOERROR;
        m_cRef++;
    }
    else if (riid == IID_IShellPropSheetExt) {
        *ppvObj = (LPSHELLPROPSHEETEXT) this;
        hr = NOERROR;
        m_cRef++;
    }
    else if (riid == IID_IShellExtInit) {
        *ppvObj = (LPSHELLEXTINIT) this;
        hr = NOERROR;
        m_cRef++;
   }
    else if (riid == IID_IContextMenu) {
     *ppvObj = (LPCONTEXTMENU) this;
      hr = NOERROR;
      m_cRef++;
    }
    return hr;
}
```

FIGURE 6: *By using multiple inheritance and typecasting, QueryInterface elegantly exports all four of the interfaces supported by MultiLaunch.*

the role of the PropPageCallback function in MultiLaunch.

BUILD YOUR OWN SHELL EXTENSIONS

Feel free to use the code in MultiLaunch to build your own shell extensions. Most of the housekeeping regarding registering and unregistering your shell extension is taken care of for you by my implementation of DllRegisterServer and DllUnregisterServer. Just modify the member functions of CShellExtension to suit the shell extension that you are creating. If you use my implementation of CShellExtension::AddPages in your shell extension, you'll have the flexibility of being able to use CPropertyPage and all of MFC's property page support in your shell extension.

MultiLaunch uses the extensibility of the Windows 95 shell to enhance the operating system's file extension association feature. It also demonstrates some cool programming tricks. Hopefully, it will make your life easier. Enjoy!

FURTHER READING

Here are a few references for further information about Windows 95 shell extensions, and COM/OLE in general:

- *Mastering OLE*, by Bryan Waters, Sybex 1995: A good general introduction to COM/OLE.
- *Inside OLE*, Second Edition, by Kraig Brockschmidt, Microsoft Press, 1995: An in-depth treatment on COM/OLE. This is a good source of further reading on using multiple inheritance for creating multiple interfaces for a single COM object.
- Technical Note #38: Microsoft Developer Network: A description of how MFC uses nested classes to implement multiple interfaces on a single COM object.
- *Programming the Windows 95 User Interface*, by Nancy Winnik Cluts, Microsoft Press, 1995: An overview of writing applications that exploit the Windows 95 user interface features, such as the new common controls and shell extensions.
- MSDN Technical Articles: MFC/COM Objects Part 5: Using Multiple Inheritance, by Nigel Thompson. A description of how the Cairo group at Microsoft uses multiple inheritance to create COM objects. □

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GUIDE TO OUR UTILITIES

ABOUT MULTILAUNCH...

DESCRIPTION MultiLaunch lets you associate more than one application with a file extension. It is a Windows 95 shell extension that you access through a file's context menu—the menu that pops up when you right-click on its icon. MultiLaunch adds a section to the context menu that lists programs you can use to load the document. It also adds a page to every file's property sheet that lets you configure the list of programs to use with this type of file.

USAGE Since MultiLaunch is a shell extension, it is in the form of a dynamic link library rather than an executable, and it must be "registered" in the Windows 95 Registry. The MultiLaunch setup program contains the DLL in compressed form and does the registration for you. When you run SETUP.EXE, the installation program will ask you where you want to install the MultiLaunch DLL (MLAUNCH.DLL). The default location is your Windows system directory, but you can store the DLL anywhere you like. Select the location, click OK, and you're ready to run.

To add multiple file associations for a given file type, right-click on a file icon of that type and select the Properties menu item at the bottom of the context menu. This will bring up the Properties dialog box. In addition to the ubiquitous General tab, which provides you with standard file information such as the size and creation date, you will see a MultiLaunch tab. Click on this tab to bring up the MultiLaunch association page. When you add an association to a file's context menu, the association applies to all files with the same extension.

You can use the Add and Delete buttons to add and remove applications that are associated with this file type. Click the Add button and you will get a standard Windows 95 Open dialog box that you can use to browse for applications. When you have finished making associations, click OK, and you're ready to launch.

If you want to remove MultiLaunch from your system, use the Unregister MultiLaunch utility that comes with MultiLaunch (UNREGML.EXE). This will safely remove all the MultiLaunch keys from your Registry. After running UNREGML.EXE, you must reboot Windows 95 before you can delete the MLAUNCH.DLL file.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

User-to-User

By Neil J. Rubenking

Visible Errorlevels in Windows 95

Many batch files make decisions based on the errorlevel returned from a program. The errorlevel values that may be returned are generally described in the program documentation or the MS-DOS user manual. In Windows 95, however, COMMAND.COM has an undocumented /Z switch that causes it to display the errorlevel returned by every DOS program you run. If you're a batch file programmer, I think you'll find this switch to be very handy.

RUBEN CHENG, *Valencia, Venezuela*

PC MAGAZINE: This is a useful tip. Mr. Cheng originally suggested adding the /Z switch to the SHELL= line in CONFIG.SYS, but errorlevel reporting is not a feature you'll want turned on all the time. When you're developing batch files in an MS-DOS window, however, enter the command COMMAND /Z. Now you're operating under a secondary command processor that reports the errorlevel for each DOS program, as Figure 1 illustrates. To return to normal operation, simply enter the EXIT command.

```
E:\WIND95>command /z

Microsoft(R) Windows 95
   (C)Copyright Microsoft Corp 1981-1995.
Return code (ERRORLEVEL):   0
WARNING: Reloaded COMMAND.COM transient

E:\WIND95>choice Which do you choose /C:ABC
Which do you choose [A,B,C]?C
Return code (ERRORLEVEL):   3

E:\WIND95>ECHO Fools rush in | find /i "foo"
Fools rush in
Return code (ERRORLEVEL):   0

E:\WIND95>ECHO ... where angels fear to
➥tread | find /i "foo"
Return code (ERRORLEVEL):   1
```

FIGURE 1: *Unsure what errorlevels a DOS program returns? Run it under Windows 95's command processor invoked with the /Z switch and find out!*

Identifying UFOs (Unidentified File Objects)

We've all faced the daunting prospect of weeding our WINDOWS and SYSTEM directories of DLLs left from software we no longer use. The PC Magazine *utility FDDLLS can help find DLLs that aren't being used, but it doesn't tell you much about them. Since a DLL's module definition string can often tell you what function the DLL performs or what software it was a part of, I wrote WHATISIT.COM to display the information.*

Sometimes the string is just a copyright notice or a repeat of the program's .EXE filename, but more often the string is a bit more descriptive. Microsoft is usually pretty good at using this string for descriptive information. For example, using WHATISIT on COMMDLG.DLL (bundled with Windows 95) produces the string "Common Windows Dialogs, Ver. 4.00." The same task can be done in QBasic (Figure 2), but the QBasic program can't read parameters on the command line.

I found out about this when a user needed to identify a screen saver by reading the information from the .SCR file itself. He needed both the section name used to store its settings in the CONTROL.INI file and the name as displayed in Control Panel. After digging around in the Windows SDK, I discovered that the section name is one of the screen saver's resource strings, and the name displayed in Control Panel comes from the screen saver's module definition string. It turns out the module definition string is a required component of all Windows executable files (.SCR, .EXE, .DLL, .DRV, .VBX, .QTC, .FON, and so forth), and it can be useful for identifying the nature of the file.

GREGORY A. WOLKING, *Orlando, Florida*

PC MAGAZINE: The WHATISIT program, both the .COM and .BAS versions, works specifically on Windows 3.1 executable files, so it starts by

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OPERATING ENVIRONMENTS OS/2's ability to let you change the size of a program object's window means that your DOS boxes can be any size you like! *Page 234*

WORD PROCESSING There is a way to set WordPerfect 6 for DOS's Print/Fax screen so that it will print just a single page. *Page 240*

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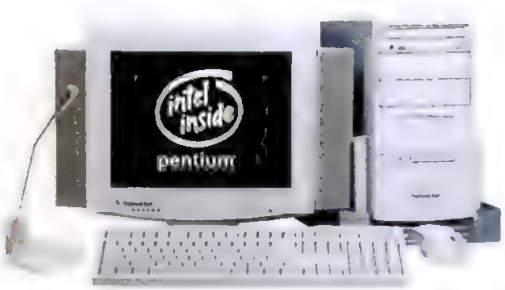

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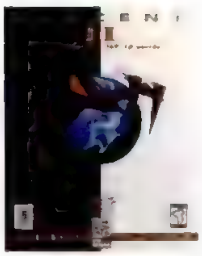

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```
'WHATISIT.BAS
'Program to display the Module Definition String
'from a Win 3.x executable file (.EXE, .SCR, .DLL, etc.)

    INPUT "File to examine"; f$
    OPEN f$ FOR BINARY ACCESS READ AS #1
    IF LOF(1) = 0 THEN GOTO NoExist
    IF LOF(1) < &H2F THEN GOTO ErrorExit
    SEEK #1, &H3C + 1
    GET #1, , wh%          'Get offset to Windows header,
    SEEK #1, wh% + 1       'which should begin with "NE"
    a$ = INPUT$(2, 1)
    IF a$ = "PE" THEN GOTO ThirtyTwo
    IF a$ <> "NE" THEN GOTO ErrorExit
    wh% = wh% + &H2C       'DWORD at offset 2CH points to
                           'nonresident name table
    IF wh% >= LOF(1) THEN GOTO ErrorExit
    SEEK #1, wh% + 1
    GET #1, , rn&
    IF rn& >= LOF(1) THEN GOTO ErrorExit
    SEEK #1, rn& + 1       'First is Module Definition
                           'String.
    l$ = INPUT$(1, 1)          'Read lenth byte.
    a$ = INPUT$(ASC(l$), 1)    'Read string data
    PRINT a$                   ' and display it
    CLOSE
    END
NoExist:
    PRINT "File is non-existent or zero-length."
    CLOSE
    END
ThirtyTwo:
    PRINT "Not compatible - 32-bit executable file."
    CLOSE
    END
ErrorExit:
    PRINT "Not a Win 3.1 executable file."
    CLOSE
    END
```

FIGURE 2: *This QBasic program extracts and displays a descriptive string from any Windows 3.1 program or DLL.*

making sure the selected file is the correct type. It opens the file and reads the 2-byte value at offset 3Ch—this should be the offset of the New Executable header within the file. Then it seeks to the specified offset and reads two more bytes. The 2-byte signature at the start of the New Executable header should be the characters NE.

If this process fails anywhere along the line, WHATISIT reports that the file is not a Windows 3.1 executable and quits. If the file is of the correct type, WHATISIT reads the 4-byte value at offset 2Ch within the New Executable header. This value is the offset of the nonresident name table within the file. The first entry in the nonresident name table is, as Mr. Wolking notes, the module definition string preceded by the string's length. WHATISIT extracts this string from the file, prints it, and quits.

The strings WHATISIT returns can be quite informative; for example, CHARMAP's is "Utility for easily selecting special characters," and the string for CALC states "Microsoft Calculator: Developed by Kraig Brockschmidt." Even more useful are the descriptive strings within .DLL files. It's handy to know that MSAFINX.DLL is a "DLL of financial functions and other stuff" and that BIVBX11.DLL is the "Borland VBX Emulation Library."

You can download WHATISIT.COM, WHATISIT.BAS, and the commented DEBUG script from PC Magazine Online.

Rehang Your Wallpaper

I recently came across a pair of settings for the [Desktop] section of the WIN.INI file in Windows 3.x that let me reposition my wallpaper bitmap anywhere on my screen instead of in the default center position. They are "WallPaperOriginX" and "WallPaperOriginY". With values greater than 0, these two settings let you specify the location of the upper-left-hand corner of your wallpaper bitmap. For example, the following two lines let you place your bitmap at the upper-left-hand corner of your screen:

```
WallPaperOriginX=1
WallPaperOriginY=1
```

You can modify the value of WallPaperOriginY alone to lower your bitmap on the desktop. For this to work, however, the bitmap should be smaller than your screen, and you should center the wallpaper in Control Panel's Desktop applet.

To position the bitmap on the right side of the display, it's helpful to know your screen resolution and the size of the bitmap in order to calculate the appropriate values (that is, the number of pixels to move the image). Or you can use the time-honored trial-and-error method.

RAYMOND CHOW, *Foxridge, Maryland*

PC MAGAZINE: Windows gives you two choices for the placement of your wallpaper bitmap. It can be tiled, in which case the image is repeated enough times to fill the screen completely, or it can be centered. But the centered style for single-image wallpaper doesn't always look good. This technique for forcing the "centered" wallpaper image to an edge or corner of the screen can yield a much better look.

Windows 95 users can take control of wallpaper position too, though the method isn't quite the same. Windows 95 retains WIN.INI and SYSTEM.INI files for certain backward-compatibility purposes, but its real repository for system settings is the Registry. Making the suggested additions to WIN.INI won't have any effect in Windows 95. Instead, carefully copy the text from Figure 3 to a file called WALLPOSN.REG. Every one of the four lines in this file is important, including the initial REGEDIT4.

Once you've saved the file, launch it by double-clicking on it in Explorer or issuing the command START WALLPOSN.REG in a DOS box. Windows 95 will respond with a message box stating that the information was successfully entered in the Registry. The change will take effect when you restart Windows or change your wallpaper bitmap.

Another setting in Windows 95 will stretch a centered wallpaper image so that it fills the screen. To activate this feature, just replace the last two lines in WALLPOSN.REG with the following:

```
"WallpaperStyle"="2"
```

Launch the modified file as before. When you restart Windows or change your wallpaper, the centered wallpaper bitmap will stretch to fill the screen. You may need to try a few different images before you're satisfied, though; not all bitmaps benefit from being stretched.

```
REGEDIT4
[HKEY_CURRENT_USER\Control Panel\desktop]
"WallPaperOriginX"="1"
"WallPaperOriginY"="1"
```

FIGURE 3: *Launch this file under Windows 95 to move a "centered" wallpaper bitmap into the top-left corner of the screen.*

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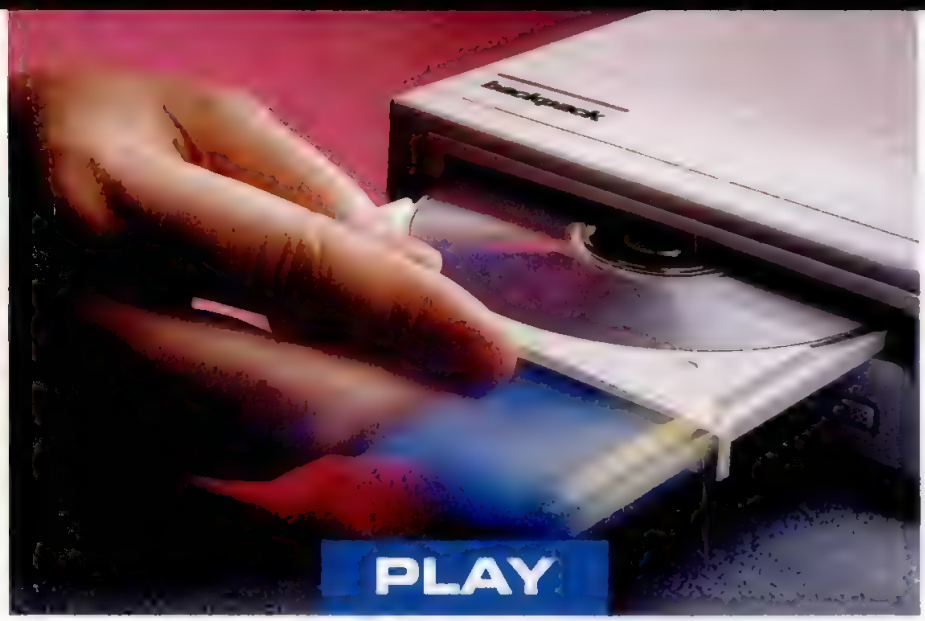

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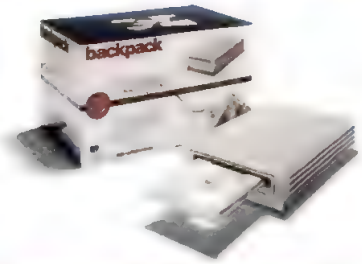

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HARDWARE

Adding a CD-ROM Drive

I want to install a CD-ROM drive in my system, but I already have two IDE hard disks. Since an IDE controller can handle only two devices, I'm not sure how to proceed. What's the easiest and most cost-effective way to install a CD-ROM drive? Does it make sense to replace the two hard disks with a single, larger one to make room for the CD?

LARRY HOWELL, *O'Fallon, Illinois*

PC MAGAZINE: There are many ways to solve your problem, but the goal of keeping costs and hassles to a minimum helps to narrow the range of choices a bit. The best solution depends on the equipment you have now and what you intend to add in the future.

If you have a sound card, that may provide the easiest solution. Many sound cards include a port for a CD-ROM, and in many cases they will support a SCSI drive, which you can get at a reasonable cost from a variety of sources. If you don't have a sound card and are running Windows, I would strongly suggest you consider adding one along with the CD-ROM drive, since many CD applications use sound. Multimedia kits provide an affordable way to add a CD-ROM drive and sound card at the same time from a single source, and nowadays most multimedia upgrade kits tend to be easy to install and reliable.

If the sound-card solution doesn't appeal to you, your best bet is to add a second controller. You can add an IDE controller and configure it as the secondary channel so that it doesn't conflict with your primary IDE controller. A second controller offers two potential benefits over swapping your two smaller hard disks for one large disk. First, if you're running Windows 3.*x* and you put both your hard disk and the CD-ROM on the same IDE channel, you won't be able to take advantage of 32-bit disk access. And with a second controller, you'll end up with an extra IDE connection available, in case you want to add a third hard disk or other IDE device in the future.

If it's likely that in the near future you'll add several devices, such as a scanner or removable hard disk, you may want to choose a SCSI controller instead. SCSI controllers cost well under $100 and offer the advantage of letting you connect up to six additional devices besides the CD-ROM drive. This approach may cost a few dollars more than using a secondary IDE controller, but it will leave you with the most flexibility for future additions.

—*Alfred Poor*

Coprocessor Conflict

I have a 386DX/33 computer that I want to use for a CAD program. I recently tried to install a math coprocessor to speed performance, but I had nothing but trouble. The installation seemed to go smoothly enough, and a utility that came with the chip indicated that everything was fine. But every time I try to run Windows, it eventually crashes. Sometimes I can actually start to load an application, while other times Windows can't even finish loading Dashboard. When I removed the math coprocessor, my system returned to normal, but when I reinstalled the chip, it again brought the system to a halt. I even tried exchanging the coprocessor for a different brand, but the newer one didn't even let the system get to the DOS prompt.

I'm stumped. I've double- and triple-

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HP OmniBook 5500 NoteBook PC

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Pentium 120	16MB/1.6GB	4X	2299
Pentium 133	16MB/1.6GB	4X	2499
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Pentium 133	8MB/1.2GB	6X	2199
Pentium 150	8MB/1.2GB	6X	1999
Pentium 120	16MB/1.6GB	6X	2499
Pentium 133	16MB/1.6GB	6X	2299
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Pentium 100	16MB/2.1GB	6X	2050
Pentium 133	16MB/2.6GB	6X	2300
Pentium 150	16MB/2.1GB	6X†	2640
Pentium 166	16MB/2.1GB	6X†	2830

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CIRCLE 082 ON READER SERVICE CARD

checked the settings on the motherboard and the installation looks fine. So, why won't it work?

BEN ALEXANDER,
Olympia, Washington

PC MAGAZINE: Hardware conflicts are a likely source of your difficulties. Math coprocessors use IRQ 13, and it's quite possible that a piece of hardware already installed on your system is also assigned to that IRQ. Your letter does not mention what other hardware, if any, you've installed in the system, but I'd start by stripping the system down to the bare minimum and seeing whether the problem disappears.

You can also check for IRQ conflicts by removing the math coprocessor chip and running a good diagnostics program that reports the status of your system's IRQs. If IRQ 13 is in use, determine which component is using it and try to reconfigure that component to use a different IRQ.

If you're able to eliminate a hardware conflict as the source of the problem, the next step is to check your software. In this case I'd start by getting rid of Dashboard and any unnecessary TSRs or drivers to see whether they might be the cause of the problem.
—*Alfred Poor*

OPERATING ENVIRONMENTS

Sizing a DOS Window In OS/2

I wrote a little DOS calendar program that I keep on my OS/2 desktop. The program works fine in a DOS session, but the DOS window seems much too large for my little character-mode calendar. The calendar really needs to pop up in a 16-line by 43-column window rather than in the default 21-line by 64-column window. Is there a way to get a DOS session to start with a specified window size?

PRESTON T. SPAULDING,
via CompuServe

PC MAGAZINE: There isn't a setting that specifically controls window size, but you can accomplish the same thing using a little-known technique. The first step is to create a separate desktop object for your program. It sounds as though you've already done this, but if not, drag a Program object from the Templates folder onto your desktop. A settings folder will open, prompting you for the path to the program. After entering the path, go to the Session page in the notebook and tell OS/2 to run the program in a DOS windowed session (Figure 1). Then go to the General page of the folder and assign an icon and a title to the program. Close the settings notebook and your program object will appear on the desktop.

Now double-click on the icon and the window will open to the standard size. Move the mouse pointer to a sizing corner of the window, then press and hold mouse button 2. Size the window the way you want it, but before you let go of the mouse button, hold down the Shift key. Don't let go of the Shift key until after you've let go of the mouse button. You have just changed the default window size for the program object assigned to the icon you used to start the program! (Note that this works for the plain DOS windowed command prompt as well.) Close the program and OS/2 will store the new window size for this program object. The next time you open the program from that icon, your calendar will appear in a window set to the size you specified.—*Brian Proffit*

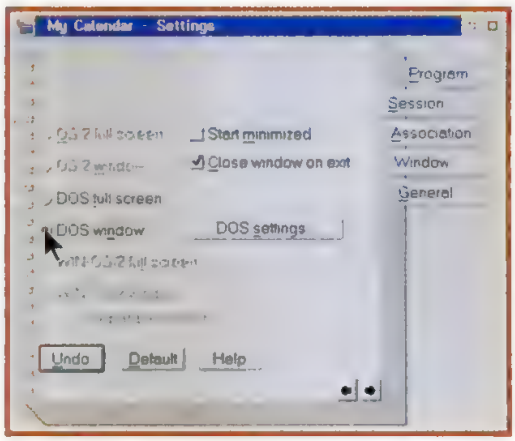

FIGURE 1: *Setting up a DOS program to run in a windowed OS/2 session.*

Limiting Users to One Windows Program

Within the next few weeks, I will begin teaching some coworkers how to use CorelDraw. During the training period we'll be sharing my computer, but I don't want them to use my other Windows applications when I'm not at my desk. Is there any way I can prevent these users from accessing my other applications, yet allow them to use CorelDraw?

JOSE CELORIO, *Woodlands, Texas*

PC MAGAZINE: Here's what you do. Open SYSTEM.INI in your favorite text editor and find the line that begins with SHELL=. In Windows 3.1, the default is "SHELL=progman.exe"; in Windows 95, it's "SHELL=explorer.exe". Duplicate the line and put a semicolon in front of the first copy (the semicolon turns this line into a comment). On the line without the semicolon, replace the default program name with the full pathname of your CorelDraw program.

When you restart Windows, it will run CorelDraw and only CorelDraw. The Startup group or menu won't be processed, programs on the LOAD= and RUN= lines in WIN.INI won't be launched, and any program name specified on the Windows 3.1 WIN.COM command line will be ignored. And of course your users will have no way to start another program.

Windows 3.1 will shut down automatically when your users terminate Corel Draw, but Windows 95 will not. To shut down Windows 95, you'll have to press Ctrl-Alt-Del to bring up the Close Program dialog box and then press the Shut Down button.

To restore Windows to full function for your own use, open SYSTEM.INI again and find the two SHELL= lines. Remove the semicolon preceding the original line and insert a semicolon at the start of the copy. That's a simple task in Windows 3.1, because once you exit Windows you're at the DOS prompt.

If you've configured Windows 95 to run just a single program, restoring a normal configuration takes a tiny bit more work. As the system is booting up, the words "Starting Windows 95..." will appear on the screen for a few seconds. Press the F8 key as soon as they show up. In the ensuing Windows 95 startup menu, select the "Command prompt only" option. Edit SYSTEM.INI to restore the original SHELL= line, then type WIN to start Windows 95.—*Neil J. Rubenking*

Timesharing for Windows NT Command Prompts

I recently installed Windows NT 3.5, and I can't figure out why a simple test doesn't produce the expected results. The test consists of starting two DOS sessions and entering DIR /S /P from the root of my C: drive at the same time. I expected both sessions to be active at the same time and scroll simultaneously. Instead, only the active window processes, while the background window is stopped. Isn't Windows NT a multitasking operating system? Is there some setting I need to change to obtain the desired result?

K. S. KALIRAI, *via the Internet*

PC MAGAZINE: Windows NT is definitely a multitasking system, and in fact your two command-prompt sessions are running simultaneously. Make a Windows application such as Program Manager the foreground task and you'll see that both background command-prompt windows scroll at about the same rate. In your experiment, the background task seems stuck, because by default Windows NT gives the foreground task as much processor

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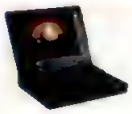

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P50 Pentium® 133 8/800MB/CD Active	4300	4200
P50 Pentium® 133 8/1200MB/CD Active	4900	4650
IBM		
701C 4/75 8/360MB Active	$1900	$1800
755CX Pentium® 75 8/1200MB Active	5500	5400
755CD Pentium® 75 8/810MB CD Act.	4789	4700
760L Pentium® 90 8/810MB Act	4150	4050
760LD Pentium® 90 8/810MB/CD Act	4600	4350
760C Pentium® 120 8/720MB 12.1" Act.	5500	5400
760CD Pentium® 90 8/1200MB 12.1" Act.	6550	6500
NEC		
2000D 4/75 4/350MB Dual	$1580	$1500
2000C 4/75 4/350MB Active	1800	1700
2200C Pentium® 75 8/810MB Active	2430	2300
4000D Pentium® 75 8/540MB Dual	3300	3150
4000CD Pentium® 75 8/810MB/CD Active	3700	3600
4050CD Pentium® 90 8/810MB/CD Active	4400	4300
4050H Pentium® 90 8/810MB Active	4400	4300
Texas Instruments		
Extensa 450T DX4/75 4/340MB Act.	$1500	$1450
Extensa 550 5/75 8/524MB Dual	1930	1880
Extensa 560CD 5/75 8/810MB/CD Dual	2830	2670
Extensa 560CDT 5/75 8/1200MB/CD Act	3700	3600
TM5100 Pentium® 90 8/1200MB Act	3550	3350
TM5200 Pentium® 120 8/1200MB Act	4300	4200
TM5300 Pentium® 133 8/1200MB Act	5300	5200
TOSHIBA		
T2130CS 4/75 8/500MB Dual	$1650	$1580
T400CS Pentium® 75 8/810MB Dual	2780	2630
T410CS Pentium® 90 8/810MB Dual	3250	3100
T410CDT 5/90 8/810MB/CD Active	4450	4250
T610 Pentium® 90 8/720MB Active	4100	3900
T700CS Pentium® 120 8/1200MB Dual	4849	4599
T710CDT 5/133 16/1200MB/CD 12.1 Act.	7000	6900

COMPUTERS

515MCX 5/133
16/1620MB 4XCD
$2580 $2450

	ELP	BCP
510C P/75 8/850MB	$1480	$1400
510MC P/100 8/1280MB 4XCD	1830	1730
510MCX P/100 8/1280MB 4XCD	1900	1800
515CD P/100 8/1280MB 4XCD	1730	1630
515MC P/133 8/850MB	1850	1750
510MCX P/100 8/850MB	1930	1830
510MCX P/133 8/1280MB 4XCD	2580	2450
510MCX P/166 8/1280MB 4XCD	3100	2980
AST		
Bravo LC 5X/100 8/850MB	$1430	$1350
Bravo MS 5/120 16/1600MB	1900	1800
Bravo LC 5/133 8/1600MB	2100	2000
Bravo LC 5/166 16/1600MB	2680	2550

MONITORS

ViewSonic
17GA Multimedia
.27mm 1280 x 1024
$784 $744

	ELP	BCP
14ES 14" 28mm	$279	$265
15ES 15" 28mm	380	360
15GA 15" 27mm	495	470
17GS 17" 27mm	695	660
20G 20" 28mm	1250	1200
21PS 21" 25mm	1650	1580
CTX		
1451C 14" 28mm	$255	$242
1565D 15" 28mm	370	350
1765GMe 17" 27mm	675	630
1765GMe 17" 26mm	730	695
2065 20" 28mm	1150	1100
Envision		
DX1495 15" .28mm	$280	$266
DX1595 15" 28mm	400	380
DX1795 17" .26mm	710	675
Mitsubishi Electronics		
Diamond Pro 14Plus 14" 28mm	$335	$320
Diamond Scan 15HX 15" .28mm	440	420
Diamond Scan 17HX 17" .26mm	845	805
Diamond Pro 17TX 17" .25mm	1100	1050
Diamond Pro 21TX 21" 30mm	1980	1879
NEC		
MultiSync XV15 15" .28mm	$480	$455
MultiSync XV17 17" .28mm	739	729
MultiSync XP17 17" 28mm	1080	1030
MultiSync XE21 21" 28mm	1880	1780
MultiSync XP21 21" 28mm	2250	2150
SONY		
CPD-1425 14" 25mm	$304	$241
Multiscan 15sfII 15" .25mm	490	465
Multiscan 15sxII 15" .25mm	430	410
Multiscan 17sfII 17" .25mm	895	850
Multiscan 20sfII 20" .30mm	1850	1750

VIDEO CARDS

ATI
Graphics Xpression
2MB PCI DRAM
$190 $180

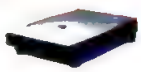
	ELP	BCP
Graphics Xpression 1MB ISA	$138	$131
Graphics Xpression 2MB VLB	185	175
WinTurbo 2MB PCI	267	253
Graphics Pro Turbo 2MB PCI	314	297
Graphics Pro Turbo 4MB PCI	439	419
Diamond Multimedia		
Stealth 64 Graphics 2200 2MB VRAM	$175	$166
Stealth 64 Video 3200 2MB VRAM	262	242
Edge 3D 2200XL 2MB PCI DRAM	278	264
Edge 3D 3240XL 2MB PCI VRAM	315	395
Edge 3D 3400XL 4MB PCI VRAM	575	545
Matrox		
9FX Vision 330 2MB PCI	$175	$166
9FX Motion 331 4MB PCI DRAM	206	195
9FX Motion 531 2MB PCI	217	206
9FX Motion 771 4MB PCI	445	425
Imagine 128 4MB PCI VRAM	830	790

PRINTERS

EPSON
Stylus Color II Inkjet
720 dpi color
$360 $340

	ELP	BCP
Stylus Color IIs 360 dpi Color Inkjet	$250	$230
Stylus Color Pro 720 dpi Color Inkjet	595	565
Stylus Color ProXL 720 dpi Color Wide	1780	1700
Canon		
BJC-4100 720x360 dpi Color Inkjet	$340	$325
BJC-610 720 dpi Color Inkjet	460	435
LBP-460 600 dpi Laser	385	365
Hewlett Packard		
DeskJet 600 600 dpi Inkjet	$212	$201
DeskJet 600C 600 dpi Color Inkjet	260	245
DeskJet 660C 600 dpi Color Inkjet	370	350
DeskJet 850C 600 dpi Color Inkjet	520	495
LaserJet 5L-FS 600 dpi Laser	520	495
LaserJet 5P 600 dpi Laser	905	860
LaserJet 5MP 600 dpi Laser	1050	1000
Color LaserJet 5 300 dpi Color Laser	6100	5800
Lexmark		
Optra E 600 dpi Laser	$580	$550
Optra R+ 1200 dpi Laser	1500	1430
Optra Rt+ 1200 dpi Laser	1680	1600
Optra Lx+ 1200 dpi Laser	2030	1930
Optra Lxt+ 1200 dpi Laser	2730	2600
Optra C 600 dpi Color Laser	6400	6100
OKIDATA		
OKIJET 2010 600x300 dpi Color Inkjet	$335	$320
OL600e 600 dpi LED	405	385
OL610e 600 dpi LED	520	490
OL610e/PS 600 dpi LED PostScript	720	685
OL810e 600 dpi LED	785	745
OL810e/PS 600 dpi LED PostScript	1130	1080
OL1200 600 dpi LED	1130	1080
OL1200/PS 600 dpi LED PostScript	1400	1330

SCANNERS



Hewlett Packard
ScanJet 4C Flatbed
600 dpi Color
$985 $935

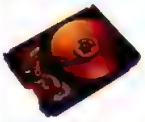
	ELP	BCP
ScanJet 4P 300 dpi Color/Grayscale Flatbed	$510	$485
ScanJet 4S 200 dpi Desktop	310	293
ScanJet 4SI 300 dpi Ethernet Desktop	2500	2380
EPSON		
Action Scanning System II 300x600 dpi	$495	$470
ES-1000C 400x800 dpi Color Flatbed	770	730
ES-1200C 600x600 dpi Color Flatbed	985	935
ES-1200C Pro 600x600 dpi Color Flatbed	1180	1130
MICROTEK		
ScanMaker E3 300x600 dpi Color Flatbed	$385	$365
ScanMaker E6 600x1200 dpi Color Flatbed	575	545
ScanMaker E6 Pro 600x1200 dpi Color	760	720
UMAX		
Vista-S6E SOHO 300x600 dpi Color Flat	$564	$534
Vista-S8 PCLE2 400x800 dpi Color Flatbed	664	629
Vista-S12 PCLE2 600x1200 dpi Color Flat	875	830
PowerLook II PCPRO2 600x1200 dpi Color	1900	1800

MODEMS

U.S. Robotics
Sportster 28.8
V.34 Data/Fax Ext.
$206 $196

	ELP	BCP
Sportster VI 28.8 V.34 Data/Fax Internal	$199	$189
Sportster 28.8/Fax PCMCIA	285	271
CARDINAL		
MVP 28.8I Int. Fax/Modem	$140	$133
MVP 28.8IV Int. Voice/Fax/Modem	167	158
MVP 28.8XV Ext. Voice/Fax/Modem	186	176
Zoom		
PM144HC II 14.4/Fax	$69	$63
PM144MT II 14.4/Fax	84	75
PM288HC II V.34 28.8/Fax	155	147
PM288MT II V.34 28.8/Fax	173	164

STORAGE



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Caviar
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$297 $282

	ELP	BCP
Caviar 635MB EIDE	$187	$177
Caviar 850MB EIDE	208	197
Caviar 1280MB EIDE	245	232
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Filepro 635MB EIDE	$191	$181
Filepro 850MB EIDE	209	198
Filepro 1275MB EIDE	228	219
Quantum		
Fireball 1080MB SCSI	$265	$251
Fireball 1280MB EIDE	232	220
Trailblazer 850MB EIDE	201	191
Trailblazer 850MB SCSI-2	199	189
Seagate		
ST1220A 1.0GB EIDE	$228	$217
ST32140 2.0GB 3.5" EIDE	340	325
ST15230N 4200MB 3.5" SCSI II	1049	999
Iomega		
ZIP 100MB PC Parallel	$204	$194
Ditto Tape Drive 3200MB Internal	248	235
Ditto Tape Drive 3200MB External	305	289
Iomega		
Jumbo 1400MB	$237	$225

MULTIMEDIA

Diamond Multimedia
Multimedia Kit
8000
$554 $524

	ELP	BCP
T1000 800MB Internal	164	156
Multimedia Kit 7000	$354	$344
Creative		
Sound Blaster AWE32 PNP	$212	$201
Discovery CD 4X Internal	309	292
Blaster CD 4X IDE Internal	156	148

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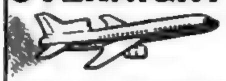

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Ascentia 900N, 910N	[illegible]	[illegible]
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COMPAQ

Contura 400CX, 410CX	4MB	$175
Contura 400CX, 410CX	8MB	$342
Contura LTE Elite	4MB	$195
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Contura LTE Elite	16MB	$630
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LaserJet 4P, 4MV, 4V, 5P, 5MP	4MB	$120
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ThinkPad 755	4MB	$209
ThinkPad 755, 760	8MB	$349
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NEC

Versa E, V, M, P Series	4MB	$189
Versa E, V, M, P Series	8MB	$369

TOSHIBA

T2100, 2105, 2110, 2130	4MB	$169
T2100, 2105, 2110, 2130	8MB	[illegible]
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9330 P-133 1 6G 16M 6X-CD 28 8	2260

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ProLinea E Pentium 100 630M 8M	1459
ProLinea E Pentium 100 1 06G 8M	1569
ProLinea E Pentium 120 1 06G 8M	1695
ProLinea E Pent Pro 150, 1 08G 16M 4XCD	4092
ProLinea E Pent Pro 180 16M 4xCD	4199
ProLinea Mini Towers	"New Models in Stock"
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Deskpro XL 5133ML P-133 1 05G 16M	3569
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IBM

PC330 P-100 540M 8M	1520
PC330 P-133 1.2GB 16M	2125
PC350 P-166 1 2G 16M	2949

NOTEBOOKS

AST

Ascentia 950 Pent 75 1 2G 10 4" Psv Clr	2289
Ascentia 950N Pent 75 800M 10 4" Psv Clr	2242
Ascentia 950N Pent 90 1 2G 8M 10 4" Act	2855
Ascentia 950N Pent 120 1.2G 11 8" Act Clr	4775
Ascentia J Pent 100 800M 10.4" [illegible]	2799
Ascentia P P-133 1 2G 8M 4xCD 11.3 Act	4825

Canon

Notejet IIICX P-90 810M 11.8" Act Clr...	5512
Notejet IIICX P-120 1 2GB 8M 11 8" Act	6699

COMPAQ

Contura 420CX DX4/75 420M 10.4" Act Clr	2519
Contura 430CX DX4-100 720M Act Clr	2899
Lte 5000 M510 P 75 510M 10 4" Psv Clr	2869
Lte 5200 P-120 1.35G 10.4" Act Clr	4689

NEC

Versa 4000C P-75 8100M w/4xCD 10.4" Psv	3710
Versa 4050C P-90 810M w/CD 10 4" Actv Clr	4394

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Extensa 550CDT P-75 810M 10 4" Actv w CD	3545
TM5100 Pentium 90 1.2G PCI 10 5" Actv	3740
TM5300 Pentium 133 1.2GB 8M 11.3" TFT	5315

MONITORS

Amdek 14" White VGA Monochrome	119
Philips Brilliance 15A w Audio + mic 28	412
Samsung 17GLSI 17" 1600x1200 26mm	835

GoldStar

1465DLS 14" 1024x768 28mm	249
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Diamond Pro17HX 17" 1280x1024 26mm	849
Diamond Pro21TX 21" 1600x1200 30mm	1889
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7BM749 14" VGA Mono 720x400	109
CM2099 14" VGA 1024x768 28mm	245
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20CM64 20" Autoscan 1280x1024 31mm	999

NANAO

F2-15 15" 28mm 1280x1024 TCO	585
F2 17 17" 28mm 1280x1024	865
F2-17EX 17" 26mm 1600x1200 TCO	989
T2-17TS 17" 25mm 1600x1200 TCO	1039
T2-17 25mm 1280x1024 TCO	1075
T2-20 20" 30mm 1280x1024 TCO	1849

NEC

XV15+ XV17+	469 799
XE17 XE21	997 1772
XP17 XP21	1029 2148

NOKIA

449E 15" 1280x768 28mm	449
447L 17" 1280x1024 28mm MPRII	689
447X 17" 1600x1200 25mm MPRII	929
445X 21" 1600x1200 25mm MPRII	[illegible]

SONY

CPD 15SX1 15" 1280x1024 25mm	409
CPD-15SF2 15" 1280x1024 25mm	469
CPD 17SF2 17" 1280x1024 25mm	849
CPD 20SF2 20" 1280x1024 25mm	1749
GDM 17SE2T 17" 1600x1200 25mm	[illegible]
GDM-20SE1 20" 1600x1200 30mm	1889

ViewSonic

V15ES 15" 1024X768 28mm	379
V17EA 17" 1024x768 27mm	655
V21PS 20" 1600X1280 25mm	1655

PRINTERS

Canon

BJ-10SX	212
BJ-30 / BJC-70	255/349
BJC-210 360dpi	239
BJC-610 720dpi Color	549
BJC-4100 720dpi Color	329
LBP-1260 12ppm 600dpi	1349

EPSON

LQ1070+ LQ1170	384/682
Stylus 1000 Stylus IIs	474/242
Stylus Color II Inkjet (720dpi)	335
Stylus Pro XL (12.5"x18")	1789

FARGO

Fotofun 3x5 color printer	383
Primera Pro	1339
Primera Pro Postscript w Photoshop	1849

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DeskJet 600 Mono / DeskJet 660C	203/359
DeskJet 680C DeskJet 850C	315/495
DeskJet 820 DeskJet 855	385/505
DeskJet 1600C/DeskJet 1600CM	1299/1969
LaserJet 4+ 12ppm 600dpi	1399
LaserJet 4M+ 12ppm 600dpi	1935
LaserJet 4V 16ppm 600dpi 11x17	1915
LaserJet 4MV 16ppm 600dpi 11x17	2772
LaserJet 5LFS 16ppm 600dpi	499
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LaserJet 5MP 6ppm 600dpi Postscript	999
LaserJet 5M NEW	7255
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520 / 521	379/489
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QMS

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NEC 4x4 CD Changer EIDE	265
Panasonic KXLD-740 2 PCMCIA	399
Pioneer DRM 624X 6 Disk Changer	284

PINNACLE MICRO

Pinnacle Micro Rec CD-ROM ext.	1339
Pinnacle Micro RCD-1000 PCI int. kit	1172

PLEXTOR

Plextor 4Plex 4x 170ms SCSI-2 int.	269
Plextor 4Plex + 4x ext. w/o cntr PnP	340
Plextor 6Plex 6x 145ms SCSI-2 int	299

SONY

CSD-760E 4x ATAPI int kit 150Kbps Trav.	99
CSD-760S 4x SCSI-2 int kit 150Kbps Trav.	225
PRD-150 Discman 2x port. kit	332
PRD-155SB Discman w/16-bit Sound	559
Spressa - CSP920S Rec. CD int.	933
Spressa -CSP9211S Rec. CD ext.	1159

TOSHIBA

Toshiba XM3701BS SCSI int	265
Toshiba TXM3701D1 6.7X ext.	329
Toshiba XM5302B 4X w ATAPI int	203

REMOVABLE STORAGE

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time as it demands. There are settings you can adjust to change the multitasking behavior, however.

Launch Windows NT's Control Panel and double-click the System applet. Press the Tasking button in the resulting dialog. You will be presented with three choices:

- Best Foreground Application Response Time
- Foreground Application More Responsive Than Background
- Foreground and Background Applications Equally Responsive

The first option is the default, because most users want the foreground task to operate as quickly as possible. If you choose the second option, the background tasks get a bigger slice of the CPU pie, but not enough to change the result of your experiment. Only if you choose to give all tasks equal shares of CPU time will you see foreground and background command-prompt sessions scrolling through a long directory listing at the same speed.

But changing the tasking priorities for the whole system will affect the performance of all programs, not just your experimental command prompts. There's another way to conduct your experiment without changing the whole system's performance. Choose Run from the Windows NT Program Manager's File menu and enter this command:

```
cmd /c START /LOW dir c:\ /s
```

Press OK and immediately run this same command again using the File | Run dialog's pull-down history list. Both instances scroll at about the same speed, because the START command's /LOW parameter has set both tasks to low priority.—*Neil J. Rubenking*

WORD PROCESSING

Changing the Size of Ami Pro's Opening Window

Ami Pro 3.1 always starts with a full-screen window, but I prefer a smaller window since I use a 17-inch monitor. This means I have to resize the window each time I open the program. Is there a way to have Ami Pro start with a particular window size each time?

CHARLES CESARINI,
Hampton, New Hampshire

PC MAGAZINE: A four-line macro will do the trick. First, decide how large you want the window, as a percentage of the screen size. For example, you might want it to be 80 percent of the screen width—large enough to hold a full line of text—and 100 percent of the height—so you can see as much text on the screen as possible. Then choose File | New to open a new file and create the following macro:

```
FUNCTION SIZE()
AppSize("",80,100)
AppMove("",0,0)
END FUNCTION
```

The FUNCTION and END FUNCTION statements are required in every macro. This particular function statement defines the function name as Size. The AppSize and AppMove commands do the work. The empty sets of double quotes in each command tell Ami Pro that the commands apply to the Ami Pro window. (More precisely, the text between double quotes tells Ami Pro which program the command applies to—no text between the quotes indicates that the command applies to the Ami Pro window itself.)

The two numbers in the AppSize command set the window at 80 percent of the screen width and 100 percent of the height. The numbers in the AppMove command define the position for the upper-left corner of the window—0,0 in this case, the upper-left corner of the screen. You can, of course, modify these numbers to match your needs.

Save the macro by choosing File | Save and set the file type to Ami Pro Macro, choosing an appropriate name such as Size. Then select Tools | User | Setup, go to the Run Macros box, make sure the Program Load check box is checked, and enter the macro name as the macro to run on start-up. (If you already have a macro that runs when you load the program, you can simply add the AppSize and AppMove commands to it instead of creating a new macro.)

Note that Lotus Word Pro 96, the successor to Ami Pro, pretty much eliminates the need for an equivalent macro. If you choose File | User | Setup | Word Pro Preferences, then go to the General card, you'll see the option Load Word Pro Maximized. Remove the check from the check box and Word Pro will remember the window size from the last time you closed the program and return to that size when you reopen it.—*M. David Stone*

Changing Dialog Box Defaults in WordPerfect 6 for DOS

The Print/Fax screen in WordPerfect 6 for DOS seems to be set in concrete for printing a full document. Is there any way to change the default from Full Document to Page?

GEORGE W. SMEJKAL,
Kilmarnock, Virginia

PC MAGAZINE: Although there isn't any option you can set to change the default, you can get the same result with a short, simple macro:

```
DISPLAY(On!)
DLGInput(On!)
PrintDlg
Type("p")
```

For this particular macro, you can actually leave out the first line (it ensures that the macro's actions will display on the screen). I've included it primarily as a reminder, should you want to use this technique to change a setting in a dialog box as part of a longer macro. WordPerfect ordinarily adds the command DISPLAY(Off!) to the beginning of each macro that you record, and it's usually a good idea to leave it there so the macro can do its work without updating the screen at each step. But in this case, you need to see the Print/Fax dialog box, and that means you need DISPLAY set to on. In a longer macro you'll want to add the DISPLAY(On!) command just before you open the dialog box.

The second line, DLGInput(On!), lets the macro accept the Type command (two lines down) to change the setting to Page. The third line, PrintDlg, opens the Print/Fax dialog box. And the final line, Type("p"), sends the character *p* to the dialog box, just as if you typed it at the keyboard. The *p* sets the dialog box to print a page.

To create this macro, press Ctrl-F10 to bring up the Record Macro dialog box, give the macro a name—ALTP would be a good choice—add an X to the Edit Macro check box, and choose OK. Then enter the macro in the editing screen and choose File | Save. To run the macro, simply press Alt-P (assuming you did indeed name it ALTP). The macro will call up the Print/Fax dialog box, set it to print a page, and wait for you to give the command to print. More generally, you can use this technique any time you want to call up a dialog box with personalized defaults.
—*M. David Stone*

DATABASES

Calculating Julian Dates in Access 95

I need a routine that automatically converts calendar dates to Julian dates and the other way around in my Microsoft Access for Windows 95 database. I tried looking through the manual, but I can't find any help.

Can you help?

GEORGE ASHLEY,
Kansas City, Kansas

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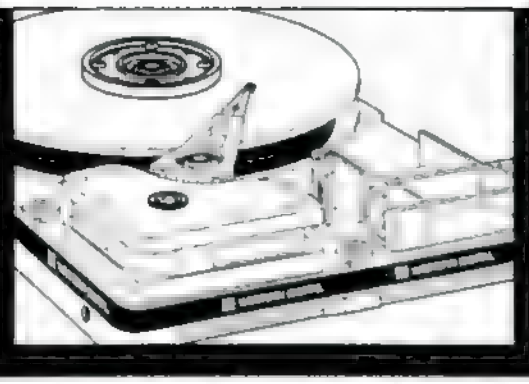

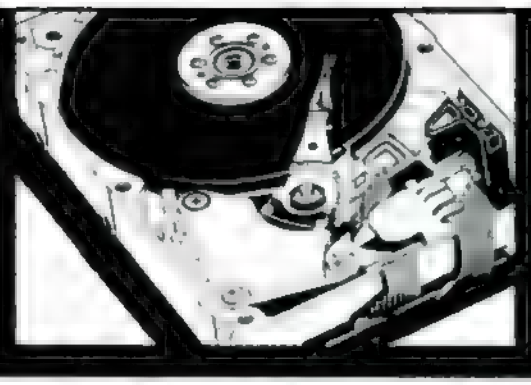

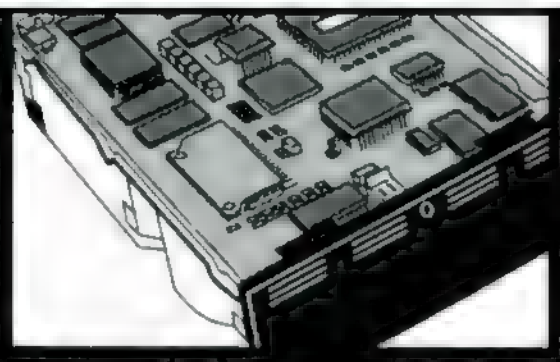

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PC Ext w/controller, software, and 5 disks	$949	PC Ext w/controller, software, and 5 disks	$1349
Mac External with software, and 5 disks	$899	Mac External with software, and 5 disks	$1299

HARD DRIVE SPECIALS

IDE				
1090MB	11ms	4500rpm	Fujitsu	$195
1080MB	11ms	5400rpm	Seagate	$209
1624MB	10ms	5200rpm	Western Digital	$269
1625MB	10.5ms	5400rpm	Seagate	$285
2167MB	10.5ms	5400rpm	Seagate	$309

Add a GSI -18 controller & cable for $36

SCSI				
2147MB	9ms	5400rpm	Micropolis	$499
2147MB	8ms	7200rpm	Seagate	$675
4294MB	8ms	7200rpm	Micropolis	$929
4290MB	8ms	7200rpm	Seagate	$999

Add an Adaptec PCI 2940Kit for $245

EXABYTE TAPE BACKUP

ExaByte's 8mm EXB-8700 Tape Drive features 7 Gig capacity native and 14 Gig capacity compressed. Blazing fast 60 Megs-per-minute backup rate! **$1779** alone **$1749** with hard drive

Complete backup kit includes external drive with controller, cable, 1 tape, 1 cleaning tape, and a CD ROM w/ Arcada backup software for DOS/Win.

MEDIA SALE!	Qty1-9	10	25	50	100
230MB Optical	$23	$19	$17	$16	$15
1.3Gig Optical	$61	$58	$55	$54	$53
SyQuest 270MB	$58	$56	$54	$53	$52

HARD DRIVES

MICROPOLIS

Micropolis low price guarantee!

SCSI			
2050MB	8.5ms	MC4221	$609
2147MB	9ms	MC4421	$499
4294MB	8ms	MC3243	$929
9100MB	12ms	MC1991	$1919
SCSI-AV Audio / Visual tuned drives			
2000MB	8.5ms	MC4221AV	$685
4294MB	8ms	MC3243AV	$1015
9100MB	12ms	MC1991AV	$2029
WIDE SCSI			
2050MB	8.5ms	MC4221W	$719
4294MB	8ms	MC3243W	$1019
9100MB	12ms	MC1991W	$1939
WIDE-AV Audio / Visual tuned drives			
2000MB	8.5ms	MC4221WAV	$769
4294MB	8ms	MC3243WAV	$1099
9100MB	12ms	MC1991WAV	$2059

Seagate

IDE			
631MB	14ms	ST3630A	$179
1080MB	11ms	ST51080A	$209
1270MB	10.5ms	ST31270A	$219
1625MB	10ms	ST31640A	$285
2167MB	10ms	ST32140A	$309
SCSI			
1050MB	9ms	ST31051N	$349
1080MB	12.5ms	ST51080N	$239
2147MB	8ms	ST32550N	$675
2150MB	9ms	ST32151N	$619
4290MB	9ms	ST15230N	$905
4290MB	8ms	ST15150N	$999
9080MB	11ms	ST410800N	$1969
WIDE SCSI			
2147MB	8ms	ST32550W	$749
4290MB	8ms	ST15150W	$1099
9080MB	11ms	ST410800W	$2069

Maxtor

IDE			
1Gig	<12ms	M71084A	$205
1.3Gig	<12ms	M71336A	$220
1.6Gig	<12ms	M71626AP	$259
2Gig	<12ms	M72004A	$299

FUJITSU

IDE			
1080MB	9.5ms	M1606T	$209
1090MB	11ms	M1614T	$199

HARD DRIVES

Quantum

IDE			
850MB	14ms	TB850A	$195
1250MB	15ms	BF1250A	$215
1280MB	12ms	FB1280A	$229
1700MB	11ms	SR31700A	$255
2550MB	15ms	BF2500A	$349
2550MB	11ms	SR32550A	$369
SCSI			
850MB	14ms	TB850S	$195
1050MB	12ms	FB1080S	$259
1280MB	12ms	FB1280S	$279
2150MB	8ms	XP32150	$639
4300MB	8.6ms	XP34300	$919

WESTERN DIGITAL

IDE			
639MB	10ms	AC2635	$179
853MB	10ms	AC2850	$195
1281MB	11ms	AC21000A	$219
1624MB	9ms	AC31600	$269
2111MB	12ms	AC32100	$329
2559MB	12ms	AC32600	$399

REMOVABLE

Syquest Removable media drives w/ 1 free disk.

SCSI	135MB	200MB	270MB
Internal	n/a	$349	$343
External	$235	$410	$403

IDE 135MB Internal / Parallel $209/$245
IDE 270MB Internal / Parallel $339/$489

Genuine SyQuest Media Qty 2-4 / 5-9 / 10+ or w/drive

44MB	$53/51/49	88MB	$55/51/49
105MB	$56/54/53	135MB	$23/21/19
200MB	$80/75/72	270MB	$59/57/56

ZIP 100MB cartridge drive by Iomega features 3.5" x 1" form factor, 13.5ms

External SCSI with 1 cartridge	$199
Parallel External with 1 cartridge	$199
Adaptec SCSI controller [A1505CDKIT] w/ drive	$49

JAZ 1 Gig cartridge drive by Iomega features 3.5" x 1" form factor

Internal SCSI with 1 cartridge	$525
External SCSI w/ 1 cartridge	$599

in high quality MegaHaus enclosure

Adaptec SCSI controller [A1505CDKIT] w/ drive	$49

100MB disks 10+ $15 1Gig disks 5+ $110

CD ROM DRIVES

SCSI				
Sanyo	SH254S	4X	190ms	$129
NEC	CDR222	4X	200ms	$129
NEC	CDR512	6X	150ms	$289
Plextor	PX63CS	6X	145ms	$325
Toshiba	XM3701B	6.7X	135ms	$239
Toshiba	XM5601B	8X	145ms	$299
IDE (ATAPI)				
Toshiba	XM5302B	4X	190ms	$79
Toshiba	XM5522B	6X	150ms	$129
Teac	CD56E	6X	110ms	$125
Teac	CD58E	8X	110ms	$185
Toshiba	XM5602B	8X	145ms	$179
NEW!	IDECD10X	10X	130ms	$289
CD ROM CHANGERS				
NEC	4Disc	4X	250ms	$189
Pioneer	6Disc	4.4X	190ms	$319

CD ROM TOWERS

Seven drives in a single enclosure.

NEC 4X $1489 Teac 6X $2439
Toshiba 6.7X $2549 Toshuba 8X $3449

1-21 drive models, & other mechanisms available.

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SAVE $10 on any tape drive with hard drive purchase!

800MB	Seagate	TST800R	$167
1Gig	Seagate	TST800+	$172
1.7Gig	Seagate	TSM1700FT	$229
3.2Gig	Seagate	TST3200RFT	$279
3.2Gig	Exabyte	EXBEAGLE96T	$249
4.4Gig	Seagate	TSM1700+	$289
IDE			
2-4Gig	Seagate	TSM4000A	$379
4-8Gig	Seagate	TST8000A	New
SCSI			
2Gig	HP	C1534A	$699
2Gig	Seagate	C4320RT	$699
2-4Gig	Seagate	TSM4000	$379
2-4Gig	Seagate	C4324RP	$799
2-4Gig	HP	C1536A	$799
4-8Gig	Seagate	TSM8000	New
4-8Gig	Seagate	C4326NP	$909
4-8Gig	HP	C1533A	$949
3-7Gig	Exabyte	8205XL	$1269
7-14Gig	Exabyte	8505XL	$1889

Call for backup software, extra tapes, cleaning kits

CONTROLLER CARDS

IDE	Alone	w/Drive
GSI 16Bit Enhanced IDE		
1533-18 2 IDE	$41	$36
1533-21 2IDE, 4 Floppy	$53	$48
1533-32 2IDE, 4 Floppy, IO	$100	$105
TEKRAM		
DC280E, 4 drive Enhanced VESA, 2 16550 serial ports, 1 EPP parallel port, 1 game port	$55	$50
SCSI		
ADAPTEC (Save $10 with Hard Drive purchase)		
ISA A1505 Kit (no hard drive suport)		$60
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ISA A1520 Kit		$145
ISA A1522 Kit		$155
ISA A1542C Bare / Kit		$210 /$270
EISA A2742 Kit / Wide kit		$379 / $409
VESA A2842 Kit		$255
PCI A2940 Kit /Ultra Wide kit		$259 / $305

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OPTICAL DRIVES

Fujitsu 230MB	$419
HP 2.6Gig	$2209
Maxoptix 2.6Gig	$2019
Pinnacle 4.6 Gig	$1499

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Get the the most from your hard drive—get the right controller! Insight carries a vast selection—just call!

Capacity**	Model	Access	Cache	RPM	MaxTrnsf. Rate	Form/Ht.	Interface	Mfr's Wty	Prod. Code	Price
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850MB	Caviar	10ms	64	4,500	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD2850A	$199.99
1080MB	Caviar	10ms	128	5,200	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD21000A	209 99
1280MB	Caviar	10ms	128	5,200	16 6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD21200A	219 99
1620MB	Caviar	10ms	128	5,200	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD31600A	269.99
2113MB	Caviar	10ms	128	5,200	16 6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD32100A	329.99
2559MB	Caviar	10ms	128	5,200	16 6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	WD32500A	399 99
Seagate										
810MB	Marathon	16ms	120	4,500	16.6Mbytes	2.5" 19.15MM	2.5" Fast ATA-2	3 Year	ST9816AG	$399.99
541MB	Cabo 541	14ms	64	3,600	16.6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST3541A	179.99
631MB	Medalist XE	14ms	120	3,811	13.3Mbytes	3.5" 1"H	Fast ATA	3 Year	ST3630A	179 99
1082MB	Cabo 1080	14ms	64	3,600	16.6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST31081A	CALL
1275MB	Cabo 1276	12.5ms	64	4,500	16.6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST31276A	229.99
1623MB	Cabo 1621	14ms	64	3,600	16.6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST31621A	279.99
1282MB	Medalist SL	10.5ms	128	5,400	16.6Mbytes	3.5" .75"H	Fast ATA-2	3 Year	ST51270A	235.99
2113MB	Medalist	10ms	128	5,400	16 6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST32140A	329 99
4250MB	Medalist	10.5ms	128	5,400	16 6Mbytes	3.5" 1"H	Fast ATA-2	3 Year	ST34250A	CALL
In Touch with Tomorrow **TOSHIBA**										
810MB	Slimline	13ms	128	4,200	13 3Mbytes	2.5" 12.7MM	IDE	1 Year	MK1926FCV	$449.99
1300MB	Slimline	13ms	128	4,200	13 3Mbytes	2.5" 12.7MM	IDE	1 Year	MK1301MAV	699.99
1300MB	Full Height	13ms	128	4,200	13.3Mbytes	2.5" 19MM	IDE	1 Year	MK2720FC	599 99
2100MB	Full Height	13ms	128	4,200	13.3Mbytes	2.5" 19MM	IDE	1 Year	MK2101MAN	CALL
FUJITSU										
1090MB	Winchester	12ms	64	4,500	16 6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	FJ1614A	$209.99
Quantum										
850MB	Trailblazer	14ms	128	4,500	16.6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	QUTR850A	$209.99
1286MB	Bigfoot	15.5ms	128	3,600	16.6Mbytes	3.5" .75"H	Fast-ATA-2	3 Year	QUFB1286A	235.99
1280MB	Fireball	12ms	128	5,400	16.6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	QUFB1280A	239.99
1708MB	Sirocco	11ms	128	4,500	16.6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	QUSR1708A	319.99
2577MB	Bigfoot	15.5ms	128	3,600	16.6Mbytes	3.5" .75"H	Fast-ATA-2	3 Year	QUBF2577A	419.99
2550MB	Sirocco	11ms	128	5,400	16.6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	QUSR2550A	429.99
Maxtor										
1084MB	Durango	11ms	64	4,500	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	MX71084A	$199.99
1336MB	Durango	11ms	64	4,500	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	MX71336A	239 99
1670MB	Durango	11ms	64	4,500	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	MX71626A	279 99
2004MB	Durango	11ms	64	4,500	16.6Mbytes	3.5" 1"H	Enhanced IDE	3 Year	MX72004A	329.99
1080MB	Deskstar	10.5ms	512	5,400	16 6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	IB94G3186	$269.99
1700MB	Deskstar	12ms	128	4,500	16 6Mbytes	3.5" 1"H	Fast-ATA-2	3 Year	IB06H8724	329.99

**Based upon mfr's quoted capacity where 1MB=1,048,756 bytes

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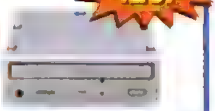

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1080MB	Medalist SL	12.5ms	128	5,400	10Mbytes	3.5" .75"H	Fast SCSI-2 A/V	3 Year	ST51Ø8ØN	$249.99
1050MB	Hawk 2XL	9ms	512	5,411	20Mbytes	3.5" 1"H	Ultra Fast SCSI	5 Year	ST31Ø55N	349.99
2149MB	Hawk 2XL	9ms	512	5,411	20Mbytes	3.5" 1"H	Ultra Fast SCSI	5 Year	ST32155N	629.99
2149MB	Hawk 2XL	9ms	512	5,411	40Mbytes	3.5" 1"H	Ultra Wide Fast SCSI	5 Year	ST32155W	CALL
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4294MB	Hawk 4	9ms	512	5,411	10Mbytes	3.5" HH	Fast SCSI-2 A/V	5 Year	ST1523ØN	929.99
4294MB	Caymen	9ms	512	7,200	10Mbytes	3.5" 1"H	Fast SCSI-2 A/V	5 Year	ST142Ø7N	999.99
2147MB	Barracuda 2LP	8ms	512	7,200	10Mbytes	3.5" 1"H	Fast SCSI-2 A/V	5 Year	ST3255ØN	765.99
2147MB	Barracuda 2LP	8ms	512	7,200	20Mbytes	3.5" 1"H	Fast Wide SCSI-2 A/V	5 Year	ST3255ØW	819.99
2150MB	Barracuda 2LP	8ms	512	7,200	20Mbytes	3.5" 1"H	Ultra SCSI	5 Year	ST32171N	CALL
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4294MB	Barracuda 4	8ms	1,024	7,200	10Mbytes	3.5" HH	Fast SCSI-2 A/V	5 Year	ST1515ØN	1,099.99
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4300MB	Atlas	8ms	1,024	7,200	10Mbytes	3.5" HH	Fast Wide SCSI-2	5 Year	QUXP343ØW	1,079.99
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2100MB	Ultrastar	7.5ms	512	7,200	10Mbytes	3.5" 1"H	Fast SCSI-2	5 Year	IB94G3Ø54	$1,049.99
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PS/2 90 XP 95 XP, P75 (port) 56, 57 (all models)
PS/1 Consultant, Essential, Expert models, PS/1 Pro M2123

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16MB	149320-001	$369	32MB	149147-001	$759

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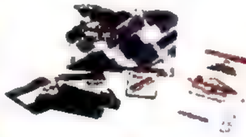

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	16MB	199017-001	$479
Contura 400, 410, 420, 430	4MB	147653-001	$125
	8MB	147655-001	$225
	16MB	147657-001	$619
Elite 5000	8MB	213515-001	$225
	16MB	213515-002	$459
	32MB	213515-003	$999
	64MB	213515-004	$2,089

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Model	MB	Part No.	Price
Latitude XPi, P75, P90	8MB	310-3435	$259
	16MB	310-3436	$579

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Model	MB	Part No.	Price
ThinkPad 360	4MB	84G5689	$125
	8MB	84G5692	$225
	16MB	84G5995	$459
ThinkPad 365, 365CD	4MB	92G7287	$151
	16MB	92G7293	$599
ThinkPad 701	4MB	04H6193	$125
	8MB	04H6194	$225
	16MB	04H6195	$409
ThinkPad 700, 720	4MB	07G1419	$126
	8MB	07G1420	$225
	16MB	07G1421	$579
ThinkPad 760, 760CD	8MB	92G7316	$322
	16MB	92G7316	$699

NEC

Model	MB	Part No.	Price
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	8MB	OP-410-1202	$225
	16MB	OP-410-1203	$599
Versa V, M, P, 4000, 4050, 4080	4MB	OP-410-4001	$126
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	16MB	FR-PCF7M-AC	$579
HiNote Ultra	4MB	FR-PCF8M-AA	$141
	8MB	FR-PCF8M-AB	$265
	16MB	FR-PCF8M-AC	$579

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Extensa 450	4MB	9803932-0001	$151
	8MB	9803950-0001	$289
	16MB	9803933-0001	$599
Extensa 550 550CD, 560, 560CD	8MB	9809810-0001	$285
	16MB	9804841-0001	$599
	32MB	9809811-0001	$1,139
TM5000, 5010, 5030, 5100, 5200	8MB	9798816-0001	$303
	16MB	9798816-0002	$719
TM 4000M	4MB	9793357	$171
	16MB	9793358	$739

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T2100 T2105, T2110, T2115, T2130 T2135, T2150, T2155	4MB	NW2026U	$125
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	8MB	PC-PA2013U	$249
	16MB	PC-PA2014U	$399
	32MB	PC-PA2015U	$1,139
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	8MB	PC-PA2020U	$269
	16MB	PC-PA2023U	$549
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	16MB	NW2032U	$459
	32MB	NW2034U	$829
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	8MB	501488-002	$225
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	16MB	501392-003	$459
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4MB	C2065A	$99	8MB	C2066A	$199

HP LaserJet 4P, 4MP, Color LaserJet

2MB	C3131A	$79	4MB	C3132A	$99

HP DeskJet 500, 500C, 520, 520C, 550C, 560, 560C

256K	22707B	$40			

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4MB	C3132A	$99	8MB	C3133A	$199

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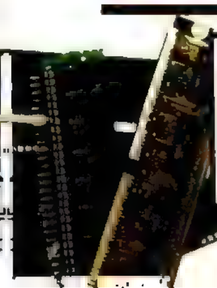

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```
'*******************************************************
' Public Function DateToJulian( dtmDate )
' Access 95
' Converts the passed calendar date to a Julian date
' number.
'*******************************************************
Public Function DateToJulian(dtmDate As Date) As Long
DateToJulian = (dtmDate - #1/1/100#) + 1757585
End Function
```

```
'*******************************************************
' Public Function JulianToDate( lngJulian )
' Access 95
' Converts the passed julian date number to a calendar
' date
'*******************************************************
Public Function JulianToDate(lngJulian As Long) As Date
JulianToDate = lngJulian - 1757585 + #1/1/100#
End Function
```

FIGURE 2: *Use these functions in Access 95 to convert a calendar date to a Julian date number, or vice versa.*

```
'*******************************************************
' Public Function DateToNumericDayYear(dtmDate As Date)
' Access 95
' Converts the passed date to the numeric day of the year
' (1-366)
'*******************************************************
Public Function DateToNumericDayYear(dtmDate As Date) As
➥Integer
DateToNumericDayYear = dtmDate - _
   DateSerial(DatePart("yyyy", dtmDate), 1, 1) + 1
End Function
```

```
'*******************************************************
' Public Function NumericDayYearToDate( intNum )
' Access 95
' Converts the numeric day of the year (1-366) to a
' calendar date
' in the current year
'*******************************************************
Public Function NumericDayYearToDate(intNum)
NumericDayYearToDate = _
  DateSerial(DatePart("yyyy", Date), 1, 1) + intNum - 1
End Function
```

FIGURE 3: *Use these functions in Access 95 to convert a calendar date to the equivalent numeric day of the year, or vice versa.*

PC MAGAZINE: The two routines in Figure 2 will help, but first let me define the term *Julian date*. According to the *Academic American Encyclopedia:* "The Julian day is the unit of a chronological system, created by Joseph Scaliger in 1582, in which any day is measured by counting the number of days from an arbitrary zero day, Jan 1., 4713 B.C., at noon, Greenwich time. It is now used mostly in astronomy to calculate the number of days between two widely separated periodic events, such as eclipses. The Julian date (JD) of Jan. 1, 1980 (at noon) is JD 2,444,240."

Some database packages have built-in functions to return this value. For example, in Visual FoxPro, calling SYS(11) and passing it a date returns the Julian number for that date. If you try this with 1/1/80, as in

```
? SYS(11, {1/1/80})
```

you'll get back 2,444,240, as expected. There's no such built-in function in Access, but the DateToJulian function shown in Figure 2 does the same thing.

DateToJulian works by determining the number of days elapsed since Scaliger's zero day. Because Access doesn't support dates that go all the way back to Scaliger's zero day, you cannot simply subtract that date from the one passed to the function. Instead, you must take note of the Julian date for the first date that Access considers valid, then add that constant to the number of days elapsed between the date passed to the function and Access's zero day.

Because Access's range of valid dates starts at Jan. 1, 0100, the function first determines the number of days that have elapsed since then and adds the Julian date for Jan. 1, 0100, which is 1,757,585. The result is the Julian date number for the date passed to the function. The JulianToDate function in Figure 2 reverses this process to convert a Julian date number into a calendar date.

Some applications calculate the number of days since the first of the year and call that a Julian date, although I think it's more accurate to call it the *numeric* day of the year to avoid confusion with Scaliger's Julian date. You can use the functions in Figure 3 to convert a date to the numeric day of the year or vice versa. The basic idea is to start by getting a date value that represents the first of the year for the year of the date in question. Once you have that, the rest is easy, thanks to Access's ability to perform date arithmetic.

The DateToNumericDayYear function works by subtracting the first of the year from the date passed to the function and then adding 1. First Access's DatePart function is used to determine the year. Then the DateSerial function is used to construct a date for January 1 in that year. After that, it's a simple matter of taking the date passed to the function, subtracting the first of the year, and adding 1.

The NumericDayYearToDate function works similarly. First, the current year is determined using DatePart and the Date function. Then the DateSerial function is called to return a date for the first of the year. After that, you add the number that was passed to the function to the first of the year and subtract 1.

You can download the code mentioned here from PC Magazine Online. Look for the filename JULIAN.AB. The sidebar "Guide to Our Utilities" in this issue's Utilities column contains detailed downloading instructions.
—*Sal Ricciardi*

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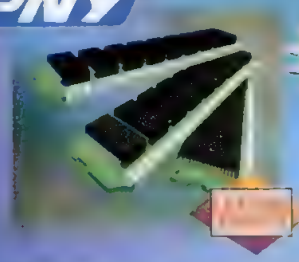

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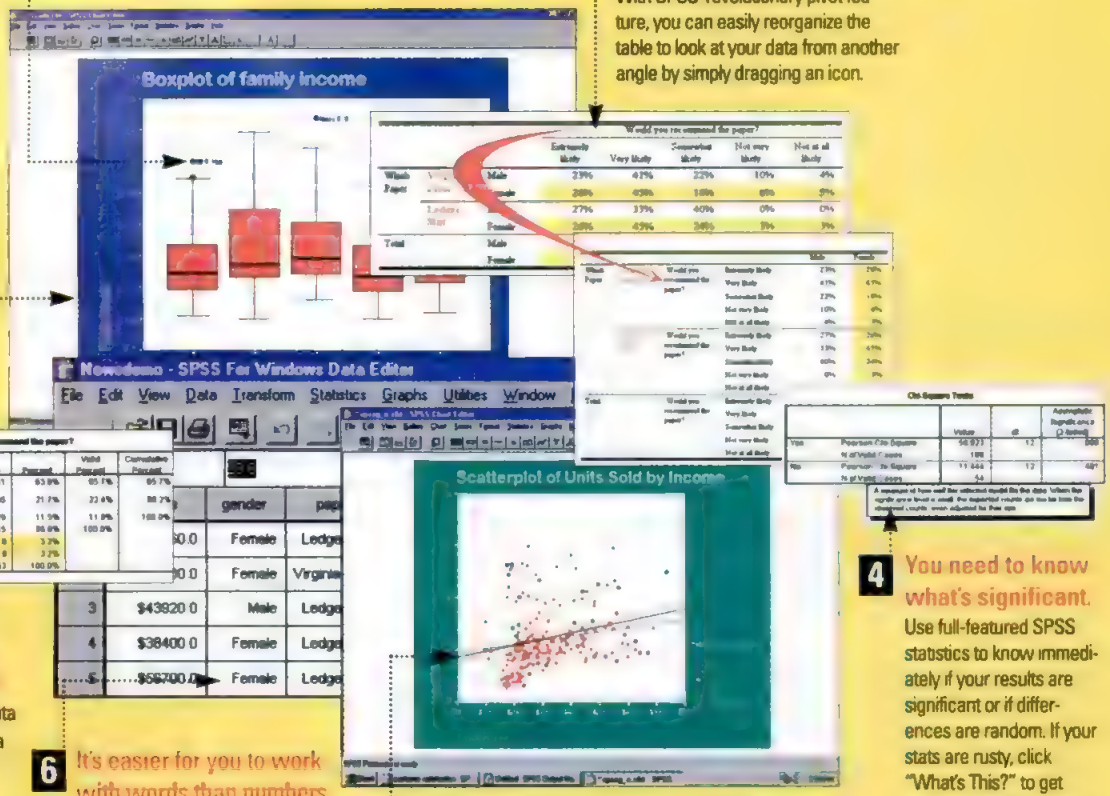

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Deskpro System Pro 386/33 486/25 486/50L	2/8/32Meg	91/244/854
Deskpro 4/66i 4/33i 4/25iS 3733i 3/25i	2 4 8Meg	69/109/209
Deskpro "M" Series	Expansion Board OK	119
Deskpro 450 486 4100 575 590 5120 5133	4/8/16/32Meg	109/199/399/699
Deskpro XE 433S, 450, 486	2/4/8Meg	69/109/209
Deskpro XE 560	8/16/32/64/128Meg	178/342/688/1398/Call
Deskpro XL450 486, XL560 x586, XL575, 5100 x590	4/8/16/32/64Meg	109/209/399/699/1300
Presario 433 CDS520 CDJV520 CDL524 CDS526 CDTV528 [illegible] CDS920 CDTV920 924 CDS924 CDS964	4/8/16/32Meg	89/171/334/699
Presario 400 Series 600 Series 800 Series	2/4/8/16/32Meg	69/109/209/399/699
Presario CDS774 CDS972 CDS982 CDTV978 CDS974 (in pairs) CDS992 7152 7170 7180 9546 9548 9564	4/8/16/32Meg	89/171/334/699
Prolinea 4/25S 4/33 4/33S 4/50 486 CDS	1/2/4/8Meg	59/69/109/209
Prolinea MT 4/33S 4/50 4/66 Enhanced 4/33S 4/50S 450 486	4/8/16/32 Meg	109/209/349/699
Prolinea 450 486 4100 575 590 5120 575 590 5120 575 max 5100 max 5133 max	4/8/16/32Meg	109/209/349/699
Prosignia 300 575 590 500 5/90 500 5/120 (install in pairs)	4/8/16/32Meg	89/171/334/699
Protect 1500 5/75 5/100 1500R 5/75 5100 (install in pairs)	4/8/16/32Meg	89/171/334/699
Prolinea 1000 5/60 Prosignia 5/60 (install in pairs)	8/16/32/64/128	171/334/699/1398/2900
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LTE 386S/20	4Meg Module	121125-002	149.00
LTE Lite 20 25 25C	4Meg Module	129769-002	149.00
LTE Lite 20 25 25C	8Meg Module	129769-003	269.00
LTE Lite 20 25 25C	16Meg Module	129769-004	580.00
LTE Lite 425C 33C/25E 25L	4Meg Module	142337-002	134.00
LTE Lite 425C 33C/25E 25L	8Meg Module	142337-003	250.00
LTE Lite 425C 33C/25E 25L	16Meg Module	142337-004	480.00
SLT 386	4Meg Module	118305-001	129.00
Concerto LTE Elite	4Meg	144790-001	129.00
	[illegible]	144790-002	219.00
	16Meg	144790-003	569.00
Contura 320, 325	4Meg	139498-001	129.00
	8Meg	139499-001	229.00
Contura 400 410 420 430	4Meg/8Meg/16Meg		139/225/399
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2.1 SCSI		629						

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T2100 2105 2150 2155 2140 2115	4Meg/8Meg/16Meg/24 Meg		129/259/449/749
T4400SX SXC T6400 T6600	4Meg	PC-PA2004U	164.00
T4400SX SXC T6400 T6600	8Meg	PC PA2005U	279.00
T4400SX SXC T6400 T6600	16Meg	PC PA2010U	589.00
T4500 C 14600 T4700 T1900 C T1910 T1950 (3.3 v)	4Meg	PC PA2012U	129.00
T4500 C 14600 T4700 T1900 C T1910 T1950 (3.3 v)	8Meg	PC-PA2013U	239.00
T4500 C 14600 T4700 T1900 C T1910 T1950 (3.3 v)	16Meg	PC PA2014U	489.00
T4700 4800 4850 (Hard Drive)	810Meg 1.3 Gig		709/819
T3400CT T2400 T3600	4Meg/8Meg/16Meg	PC-PA2019U	129/249/519
T3100SX T3200SX	2Meg	PC15-PA8308U	99.00
[illegible]	4Meg	PC15-PA8310U	139.00
T600 610 CT Edo	8Meg/16Meg/32Meg		311/610/1207
[illegible]	8Meg/16Meg/32Meg		366/732/1464
T400CS 400CDT T100, 105 Edo	*8Meg/16Meg/32Meg*		*311/610/1207*

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MODEL	AMT UPGRADED	MANU PART #	PRICE
ACER 730 735C 760 780	2Meg 4Meg 8Meg		69/139/264
ACER 783 785 782 794 786, 787	4Meg 8Meg 16Meg		139/268/524
ACER 750	4Meg 8Meg 16Meg		139/268/524
ACER Note Pro, ACER Note Lite	*4Meg 8Meg 16Meg*		*[illegible]*
ARM TS38	4Meg 8Meg 16Meg		139/269/524
AST Ascentia 900N, 800N, 810 910	4Meg 8Meg 16Meg		139/268/524
AST Ascentia 950	8Meg 16Meg		289/534
AST Bravo & Explorer	*4Meg 16Meg*	*501250-001, -002*	*[illegible]*
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	139.00
AST Power Exec 3/25C 4/25EL 4/25SL	4Meg 16Meg	501186-001 -003	139/619
AST Power Exec 4/33SL	4Meg 16Meg	501318-001.002	149/519
AT&T Globalyst 130 *(Call for other Globalyst)*	4Meg 8Meg 16Meg		119/229/509
AT&T Globalyst 200	4Meg 8Meg 16Meg		139/289/534
AT&T Safari NSX/20	4Meg	PEC 37851	219.00
Austin DX4 DX2 SX2 SX Series	4Meg 16Meg		119/449
Bondwell B310 Plus	1Meg	23050-00100	59.00
Bondwell B310V SX	4Meg		209
Canon Innova Book 150	4Meg 16Meg		129/499
Canon Innova Book 200LS	4Meg/8Meg/16Meg/24Meg		139/289/540/849
Canon Innova Book 200CD	*4Meg 8Meg 16Meg*		*[illegible]*
Canon Innova 486 10	4Meg 16Meg		119/549
Canon Notejet 486-25	4Meg 8Meg		139/289
Canon Notejet 486-33, 486C, 25 and 33	4Meg 8Meg		149/289
Canon Notejet 486c 75 100	8Meg 16Meg		289/579
DEC HiNote Ultra HiNote	4Meg 8Meg 16Meg		129/219/519
Dell Latitude LX 4100C MX, MC, M	4Meg 8Meg 16Meg		119/249/499
Dell Latitude XPI	4Meg 8Meg 16Meg		129/289/499
Dell Latitude XP 475 4100 4100CX	4Meg 16Meg		139/549
Dell Latitude 486 425 433C 433CX 450 450CX	4 Meg 16 Meg		139/549
Epson ActionNote 650 650c 660c 680cx	4Meg 8Meg 16Meg		139/289/549
Epson ActionNote [illegible] 700cx	4Meg 16Meg		119/499
Epson [illegible] 866c	4Meg 8Meg 16Meg 20Meg		119/239/499/619
Epson ActionNote 880	*4Meg 8Meg 16Meg*		*[illegible]*
Epson ActionNote 4000 Notebook	6Meg		149
Epson ActionNote 4 C/25 4LC/33 4SLC/2-50	4Meg		199
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[illegible]	4Meg 8Meg		129/289
[illegible]	4Meg	286, 386SX	139
Midwest Micro Elite SX-25 SX33 DX2-50 DX2-66	4Meg 8Meg 16Meg		119/249/499
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MPC Model 380	4Meg 8Meg 16Meg		139/269/524
NCR Safari 3180 3181	4Meg 8Meg		119/209
NEC Ultralite versa E V MP	4 Meg/8Meg 16Meg 20Meg	OP4104	129/249/499/619
NEC Versa Removable Hard Drive	810Meg 1.3 Gig		509/779
NEC Versa S	4Meg 8Meg 16Meg		129/289/489
NEC Versa 2000C & 2000D	4Meg 8Meg 16Meg		139/289/549
NEC Versa 4000	4/8/16/32Meg		119/249/499/999
Packard Bell 386SX 286	4Meg	286, 386SX	179
Packard Bell Statesman	2Meg/8Meg		69/219
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AMOUNT UPGRADED	OK 0d	2000	1	2	3	3.5	4	5	6	8	16	32
Brother [illegible]	-	-	[illegible]	[illegible]	-	-	-	-	-	-	-	-
Canon LBP 430	-	-	39	-	-	-	[illegible]	-	-	-	-	-
Canon LBP 860 1260	-	-	-	[illegible]	-	-	[illegible]	-	-	[illegible]	[illegible]	[illegible]
Canon LBP4, 4Lite, 4plus	-	-	129	179	-	-	-	-	-	-	-	-
Epson 6000 Action Laser	-	-	-	139	-	-	229	-	-	-	-	-
Epson Action Laser 1100 1600	-	-	[illegible]	79	-	-	[illegible]	-	-	199	359	-
Epson Action Laser II	-	-	74	-	173	-	-	272	-	-	-	-
Epson 8000, 1800, 4000, 4100, 4800	-	-	[illegible]	-	173	-	-	272	-	-	-	-
Epson 1000, 1500, 5000, 5200	-	-	-	[illegible]	-	-	179	-	-	-	-	-
HP 2, 2D	-	-	-	79	-	-	119	-	-	-	-	-
HP 3, 3D, 3P, 2P, 2P+	-	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-
HP 4, 4M, 4SI, 4SIMX	-	-	-	[illegible]	-	-	109	-	-	199	-	-
HP 4P, 4PLUS, 4MPlus 1600, 1600CM	-	-	-	-	-	-	79	-	-	159	-	-
HP 4L	-	-	39	-	-	-	-	-	-	-	-	-
HP 3SI	-	-	[illegible]	-	-	-	109	-	-	199	-	-
HP 5L	-	-	39	[illegible]	-	-	149	-	-	289	-	-
HP 5P, 5MP, 4V, 4MV	-	-	-	[illegible]	-	-	109	-	-	171	334	-
HP Design Jet 600, 650, 200	-	-	-	[illegible]	-	-	109	-	-	[illegible]	399	799
HP Deskjet 500, 500C, 510, 550, 560	-	[illegible]	-	-	-	-	-	-	-	-	-	-
HP Deskjet 1200C, 1200C/P	-	-	-	[illegible]	-	-	109	-	-	[illegible]	-	-
HP Paintjet XL300	54	-	-	-	-	-	[illegible]	-	-	199	379	-
IBM Laser 4019 4019E	-	-	-	-	-	139	-	-	-	-	-	-
IBM Laser 4029 4037	-	-	-	-	-	-	119	-	-	-	-	-
IBM Laser 4039 4079	-	-	-	[illegible]	-	-	[illegible]	-	-	[illegible]	-	-
Konica LP-3110 3115	-	-	119	189	239	-	-	-	-	-	-	-
Lexmark Medley 4C 4x 4SX	-	-	Call	Call	Call	-	-	-	-	-	-	-
Lexmark Optra L LX R RX	-	-	-	-	-	-	[illegible]	-	-	171	334	[illegible]
Lexmark Valuewriter 300,600	-	-	[illegible]	[illegible]	-	-	109	-	-	-	-	-
Lexmark Winwriter 200, 400, 600	-	-	[illegible]	[illegible]	-	-	109	-	-	-	-	-
NEC 90, 290	-	-	-	[illegible]	-	-	-	-	-	-	-	-
NEC 95, 97	-	-	-	79	-	-	-	-	-	-	-	-
Oki 400	-	-	-	79	-	-	-	-	-	-	-	-
Oki 400E 400EX 410E 410EX	-	-	[illegible]	109	[illegible]	-	109	-	-	-	-	-
Oki 830 840	-	-	-	[illegible]	-	-	-	-	-	-	-	-
Packard Bell PB 9500	-	-	-	139	-	-	227	-	-	-	-	-
Packard Bell 9815	-	-	-	139	-	-	229	-	-	-	-	-
Panasonic 4420/4450i	-	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-
Panasonic 4410/4430	-	-	-	[illegible]	-	-	[illegible]	-	-	-	-	-
Panasonic 4450	-	-	[illegible]	-	-	-	-	-	-	-	-	-
Panasonic 4400/5400	-	-	[illegible]	[illegible]	-	-	149	-	-	-	-	-
Panasonic 4440 5410 4600	-	-	79	[illegible]	-	-	139	-	-	-	-	-
Sharp 9400 9460 9600 9700E	-	-	[illegible]	[illegible]	-	-	[illegible]	-	-	-	-	-
Sharp 9500 E H 9700 H	-	-	79	-	-	-	[illegible]	-	-	-	-	-
TI XL PS17 PS35	-	-	49	-	-	-	-	-	-	-	-	-
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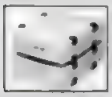
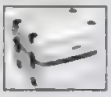

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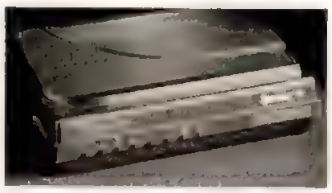

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5000CT 120MHz, 8MB, VGA	$6079.84	CDW 65468
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133MHz Pentium® processor

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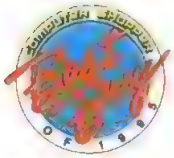

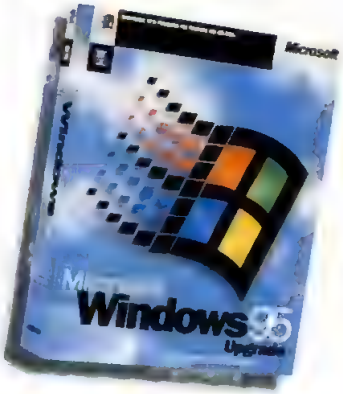

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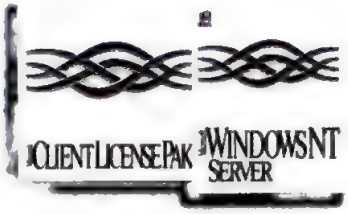

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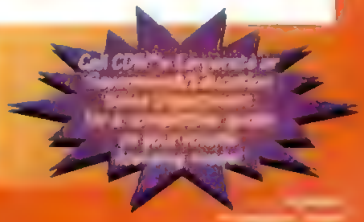

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25 User to 25 User CD	755 09
25 User to 50 User CD	1402 61
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Token Ring Auto Adapter 16/4 ISA	258 14
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EtherExpress PRO/100Mbps EISA	241 92
EtherExpress PRO/10 Fish 10BT	108 60
EtherExpress PRO/10 Fish 10BT 5pk	414 33
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TigerHub TP6 6 port + AUI	167 26
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TigerHub TP12 12 port + AUI	355 06
3608 Ethernet 8 port hub 10BT	288 21
3512 Ethernet 12+2 port hub 10BT	529 05
PC600WS ARCNET coax	123 61
ARCNET 8 port active hub coax	223 66
TokenCard Elite 16/4	211 74

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TC6245 ARCNET coax	177 24
TC5055 Ethernet 8 port hub 10BT	339 47
TCVG045 AnyLAN ISA adapter	198 22
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Link MC5 amber/green/white	269 97
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EXB-8505XL 7GB tape backup internal	1886.57

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Blaster CD 4x kit	125 69
Sound Blaster Value CD 4x kit	235 69
Phone Blaster 14 4K internal w/software	184 58
Sound Blaster 16/3D value edition (IDE)	94 63
Sound Blaster AWE32 PnP	222 19

ADS VGA to TV Elite internal	128 93
ADS VGA to TV Elite external	195 05
ALPS 4X internal CD-ROM changer	307 01
Advent PP570 speakers 35W	245 18
Advent PP270 speakers 25W	112 52
Advent PP170 speakers 5W	64 56
Advent PP622 spkrs/subwoofer	185 61
Altec Lansing ACS500 surround system	290.39
Connectix QuickCam for Windows	98 17
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Diamond Multimedia Kit 4400 4X CD int	286.26
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Jensen JPS45 speakers 10W	95.78
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Microsolutions 4X CD parallel w/sound	379.81
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NEC 6Xi	342 15
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NEC 4x4 4X, 4 disc changer	273 20
Pioneer DRM624X 4X, 6 disc changer	297 09
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Turtle Beach TBS-3001 4X 3-speed	187 80
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Mag Innovision DX1585 PnP 15"	374 14
Mag Innovision MXP17F	829 49
Mag Innovision DX1795 PnP 17"	676 32
Mag Innovision MX21F	1615 80
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Diamond Edge 2200XL 2MB DRAM	275 33
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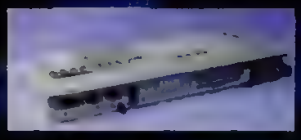

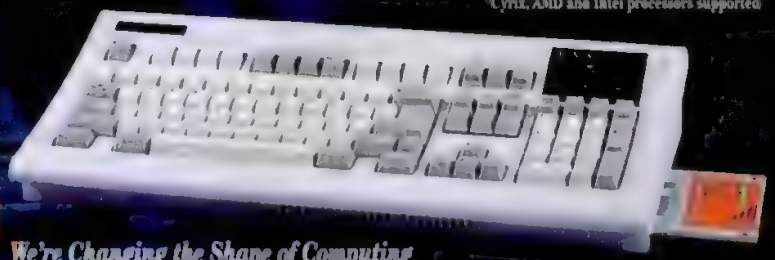

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	DX4-100	55	3v	33MHz	100-5v
	DX4-120	75	3v	40MHz	121-5v
	DX4-133	80	3v	33MHz	126-5v
Intel 486	DX-66	69	5v	33MHz	N/A
	DX4-100	100	3v	33MHz	131-5v
Pentium®	75MHz	115			
	90MHz	205			
	100MHz	215			
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	166MHz	675			
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MB486VLPCI	$110	256K	writeback	2	4	3		4	Yes	UMC	AMI	Serenity
MB486PCI	$106	256K	writeback		1	4		4	Yes	ALI	AMI	Serenity

Pentium

All Pentium® 75MHz to 200MHz CPU's are 7 Socket, have 273 Pins, and can be used with these boards When using Pipeline Burst or Synchronized Cache you can use EDO Memory

Model	Price	Cache Size	Cache Type	VLB Slots	PCI Slots	ISA Slots	30 Pin	72 Pin	Cache on Board	Chipset	BIOS	Manufacturer
MBSerenity	$155	256K	Pipeline		1	4		4	Yes	[illegible]	Award	Serenity
MBTranquility	$199	256K	Pipeline		3	4		4	Yes	[illegible]	AMI	Serenity
MBP55CMS-256	$225	256K	Pipeline		1	4		4	Yes	[illegible]	AMI	Super Micro
MBP55CMS-512	$255	512K	Pipeline		1	4		4	Yes	[illegible]	AMI	Super Micro

Pentium® Pro

These should only be used in a Network Environment

Model	Price	Cache Size	Cache Type	VLB Slots	PCI Slots	ISA Slots	30 Pin	72 Pin	Cache on Board	Chipset	BIOS	Manufacturer
MBAurora	Call	[illegible]	[illegible]		4	4		4	Yes	[illegible]	AMI	Intel
MBP6DOF	$1600	512K	Dual Pipeline		4	4		8	Yes	[illegible]	AMI	Super Micro

HARD DRIVES

Western Digital — 3 yr warranty IDE

Capacity	Size	Intrfc	Access	Cache	RPM	Part No	Price
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*280MB	3.5"/1"	E-IDE	10ms	64K/RAM	4500	WDAC21200A	225
*620MB	3.5"/1"	E-IDE	9ms	64K/RAM	5200	WDAC31600A	289

Connor — 3 yr warranty IDE

Capacity	Size	Intrfc	Access	Cache	RPM	Part No	Price
*275MB	3.5"/1"	E-IDE	12ms	64K	3600	CFS1275A	$220
*620MB	3.5"/1"	E-IDE	14ms	64K	3600	CFS1621A	255

Maxtor — 2 yr warranty IDE

Capacity	Size	Intrfc	Access	Cache	RPM	Part No	Price
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*620MB	3.5"/1"	E-IDE	12ms	128K	4480	MXT1626AP	249
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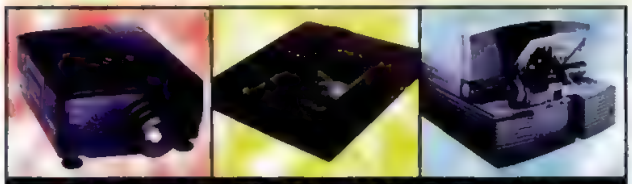

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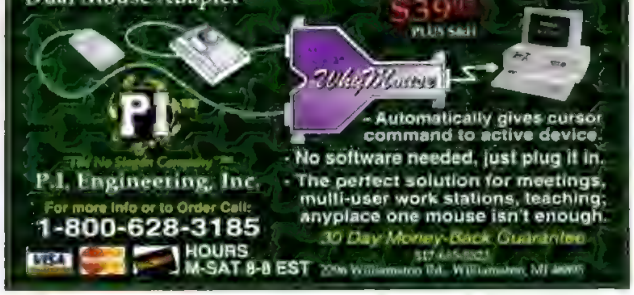

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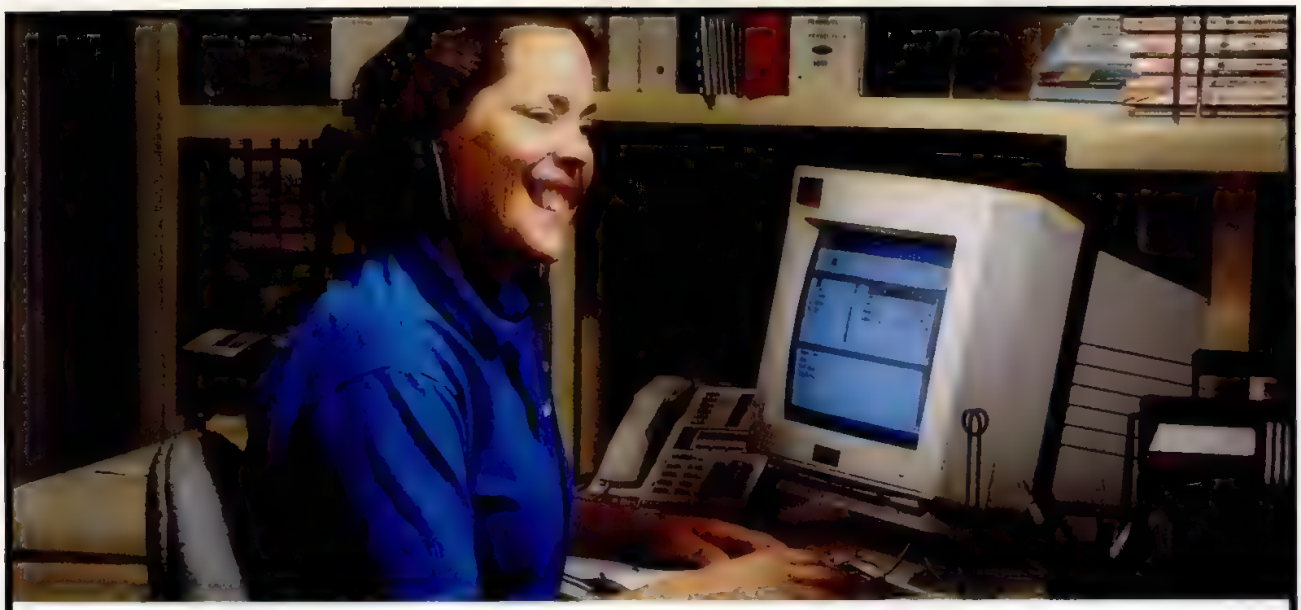

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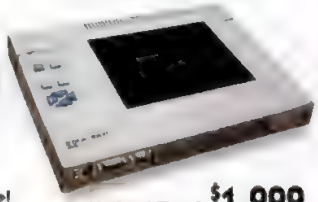

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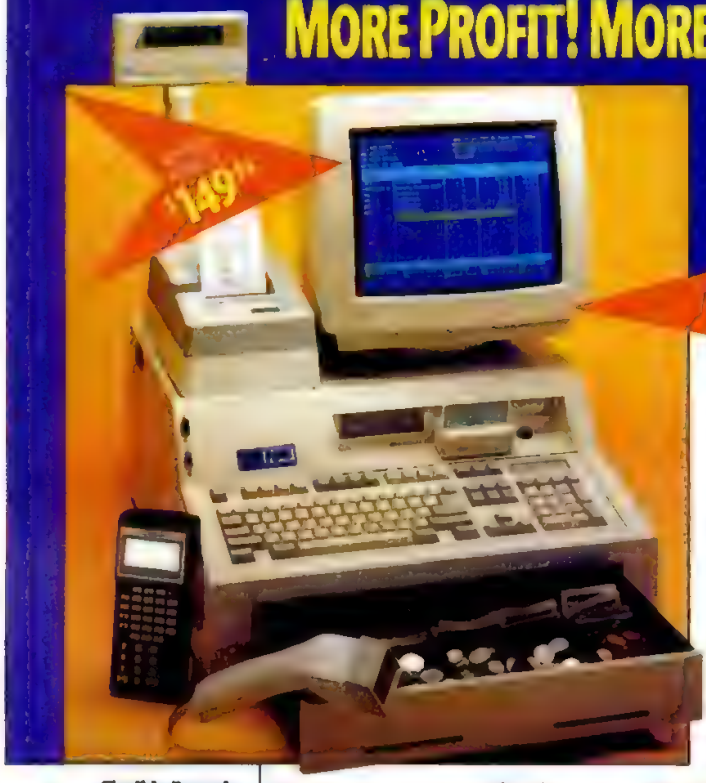

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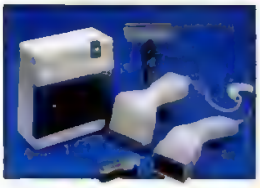

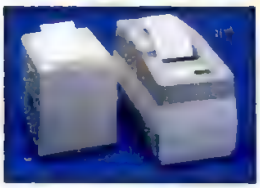

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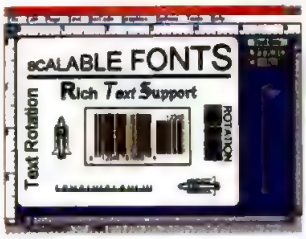

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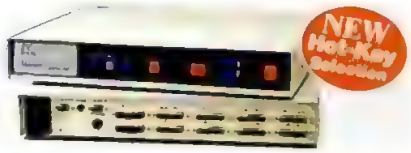

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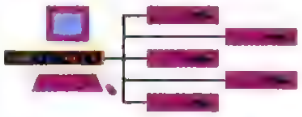

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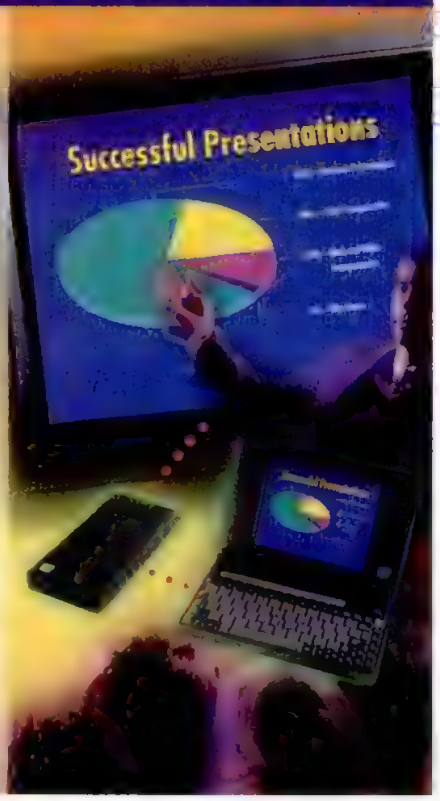

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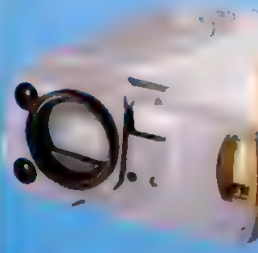

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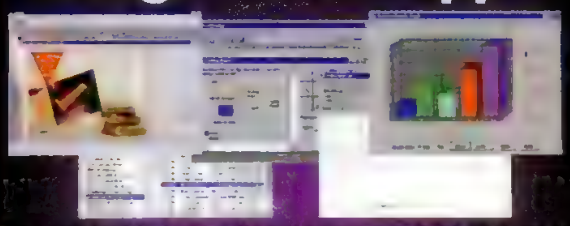

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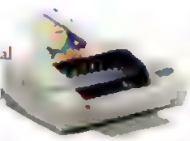

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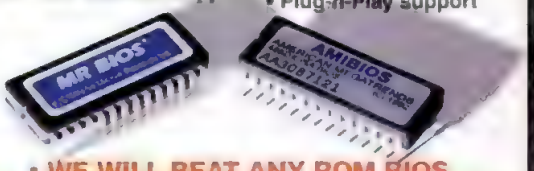

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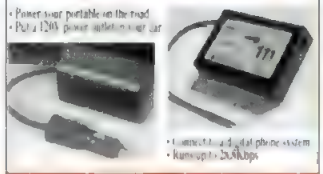

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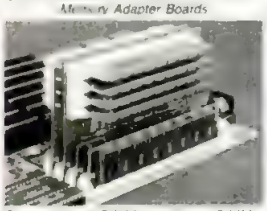

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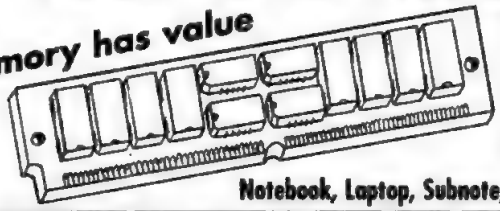

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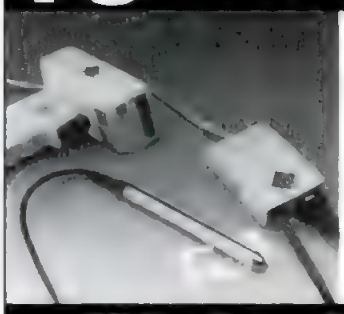

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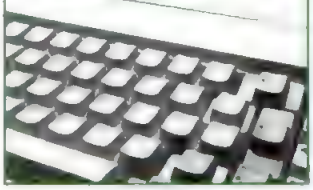

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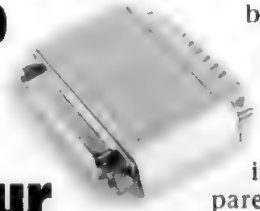

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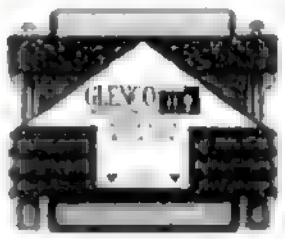

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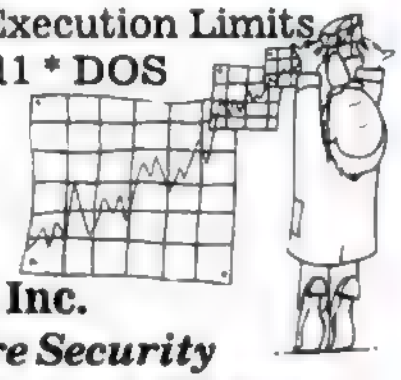

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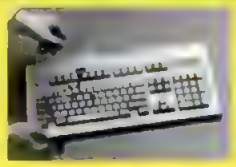

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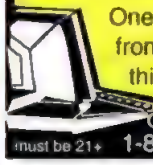

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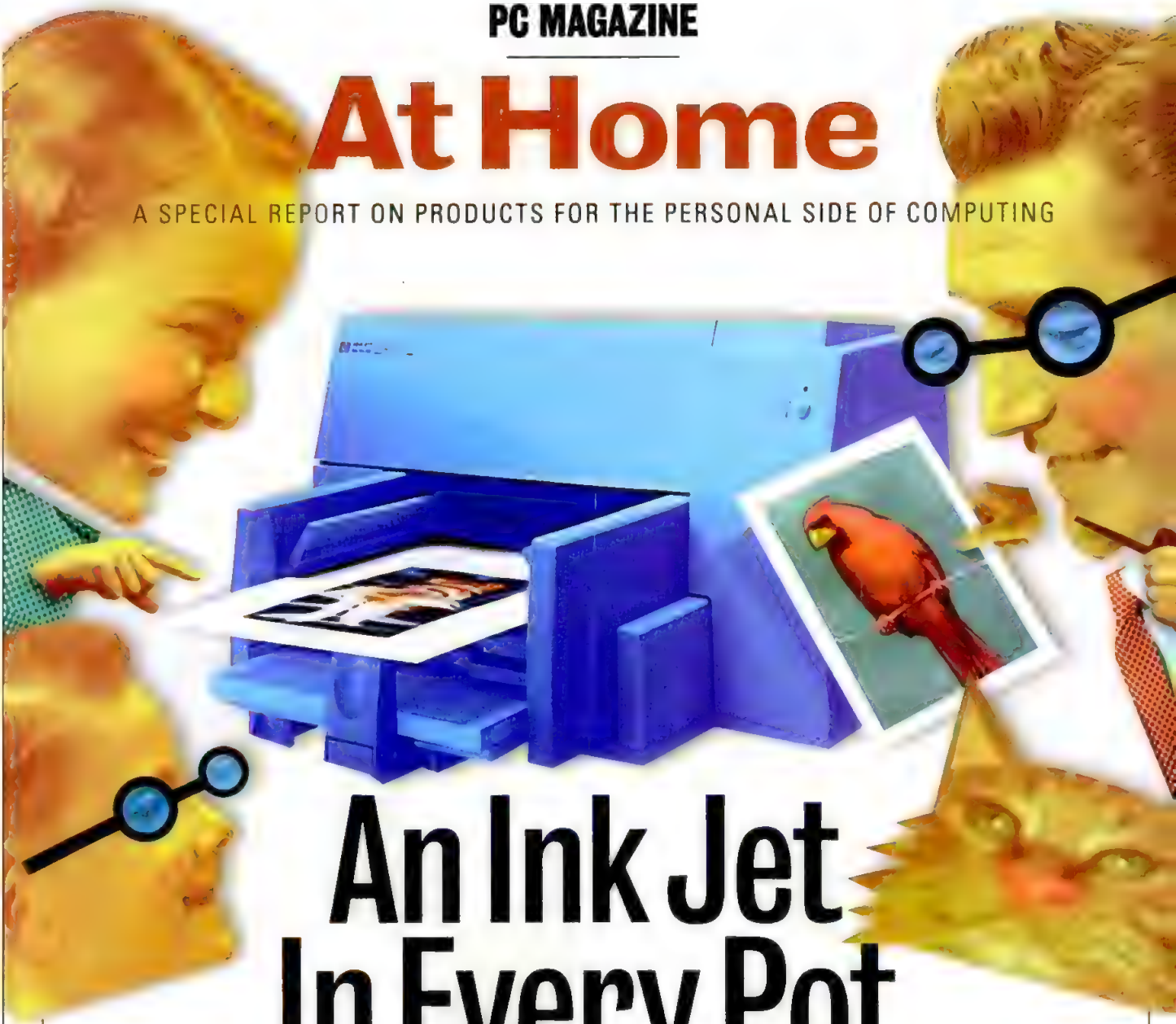
At Home

A SPECIAL REPORT ON PRODUCTS FOR THE PERSONAL SIDE OF COMPUTING



An Ink Jet In Every Pot

By Bruce Brown

For most home PC users in the market for a printer, the question is no longer what *kind* of printer to buy, but rather *which* color ink jet printer to choose. Even though several tempting laser printers now cost less than $500, the kids want color, and color in home applications for all ages tilts the balance in favor of ink jets.

The reasons are clear: Home ink jet printers are inexpensive, easy to use, and fairly cheap to operate for low-volume printing. With street prices starting at just under $200, you can buy a color-equipped ink jet printer that will print text, black-and-white graphics, kids' artwork created with drawing and paint software, and even color photos.

To find ink jets for this roundup, we looked to the four biggest ink jet sellers in the U.S.: Hewlett-Packard Co. (with 59 percent of the home market), Canon Computer Systems (21 percent), Epson America (10 percent), and Lexmark International (3 percent).

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HP DeskJet 820Cse 320
Lexmark Color Jetprinter 1020 320
Lexmark Color Jetprinter 2070 324

ILLUSTRATION BY GORDON STUDER

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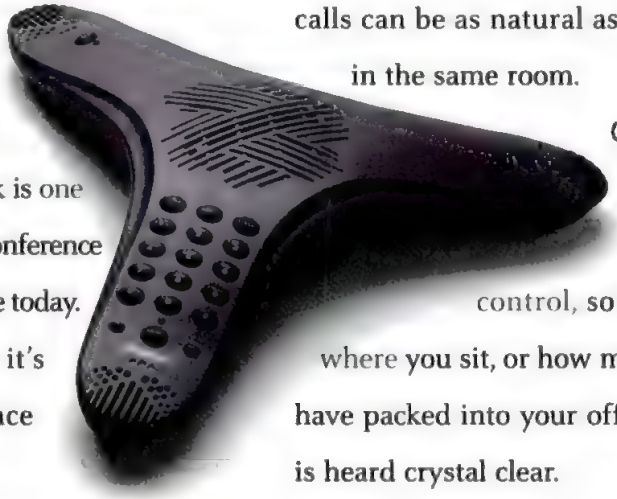

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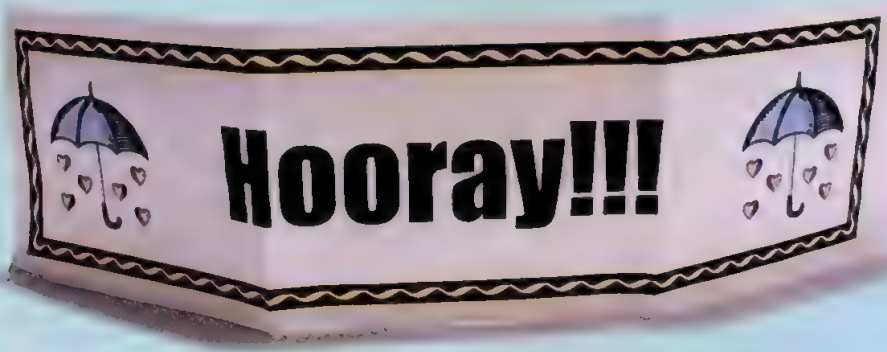
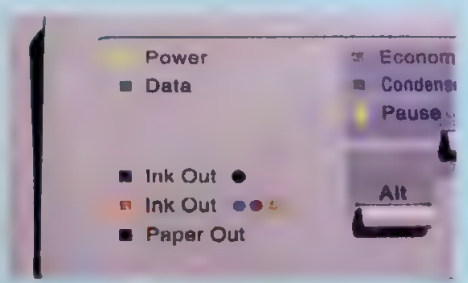
The Fine Print

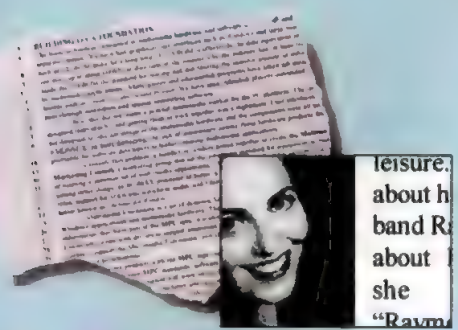


SAY IT BIG *The HP DeskJet 682C is the first ink jet printer able to print on fanfold paper. Now you can make that "I Love You" banner in color and up to 20 feet long if you like. Impress your boss with a really big spreadsheet.*

BETTER AND CHEAPER *Print quality from home ink jets has been steadily improving, and prices have continued to decline. This story's Editors' Choice four-color model costs just $330. The cost per printed page, though, hasn't declined much.*



DON'T RUN DRY *Canon's BJC-610 and Epson's Stylus Color II and Stylus Color IIs help you avoid running out of ink. An indicator light on the printer blinks while there's still a little ink left. The Lexmark printers have a software alert.*



PLAIN VS. COATED *On regular copier paper, most home ink jets still show tell-tale fuzziness. For cleaner output, you'll need coated paper (inset).*

RAINY-DAY FUN *Several printers come complete with software for various rainy-day activities. From Disney calendars to T-shirt transfers to Crayola coloring books, these extras will keep the kids busy.*

REVIEW CRITERIA

We wanted only printers that are sold to the home market for use with PCs and that include color as a standard feature. We also limited our field to printers that typically sell for no more than $500 on the street (though a manufacturer's list price might be higher).

The four vendors submitted ten printers for review. Three printers each came from Canon (the BJC-210, BJC-4100, and BJC-610) and Hewlett-Packard (the HP DeskJet 600C, 682C, and 820Cse). Epson's Stylus Color II and Stylus Color IIs and Lexmark's Color Jetprinter 1020 and 2070 round out the field.

RESOLUTION AND COLOR QUALITY

All the printers let you choose from among different resolution modes. *Resolution* is a measure of output quality, usually specified in *dots per inch* (dpi). The more dots a printer packs into a square inch, the better the output will look. The standard resolution modes (typically 300 dpi to 360 dpi) produce text and graphics output that is good enough for most tasks, while the slower (and more ink-hungry) high-quality modes (from 600 dpi to 720 dpi, depending on the printer) should be reserved for when quality really counts.

To produce color documents, ink jets combine three ink colors: cyan (art speak for light blue), magenta, and yellow. The more expensive printers use a four-color system, adding a dedicated cartridge for black ink that stays loaded all the time. This saves you the hassle of manually popping out the color-ink cartridge and dropping in a black-ink one when you want to print in black and white.

If you opt for one of the less-

expensive three-color units, you must not only continually swap cartridges, but you'll have to put up with inferior print quality for your trouble. Black text on a color page is created by mixing the cyan, magenta, and yellow inks for what is known as *composite black*. It can look muddy, with color halos sometimes visible. We recommend paying the $50 to $75 price premium to step up to a true four-color printer.

While none of the monochrome output is quite laser-quality—the ink tends to wick into the paper and spread—the black text produced by the three HP DeskJet entries was exceptional. All ten printers mustered color output that was more than adequate for jazzing up school reports and brightening rainy days with art projects, and there were several standouts, including the Epson Stylus Color II and the HP DeskJet 682C and 820Cse.

Do note that with ink jet printers, investing in high-quality paper almost always yields better results. Ink jets produce adequate text quality on plain copier paper, which costs a penny a sheet, but graphics are usually good enough only for draft copies. A slight step up to the smoother paper rated for laser printers (about 10 cents a sheet) returns a markedly better product. With coated stock made specifically for ink jets (10 to 15 cents a sheet), the colors get even richer, the blacks even blacker, and the details sharper. For the highest-quality needs, such as photo output, $1-per-sheet glossy paper can produce stunning results.

A PLEASURE TO USE

Once installed and configured, these printers were, as a group, a pleasure to use. You can print using the default settings, so you may need a printer's control software only to select special paper. Each printer's software can automatically select and print the correct colors as your work calls for them. If you want to manually select settings, the software offers a tabbed-page interface with colorful and generally easy-to-follow option selection screens.

Beyond these basics, printer vendors have started including free software targeted at home users. For instance, Canon delivers its Canon Creative for Windows package, which includes kids art software from Crayola and a Hallmark greeting card maker. Epson delivers Sierra On-Line's Print Artist 3.0 with its units, while HP gives buyers of the DeskJet 682C its Home Project Kit, which includes the excellent PrintPaks Family Fun Kit and Disney's Mickey and Friends Print Studio CD-ROM. HP bundles Microsoft Publisher for Windows 95 with its home office–oriented DeskJet 820Cse.

An important point to keep in mind before you buy is reliability of a printer and a vendor's service policy. In our annual study of service and reliability ("Tipping the Balance," November 7, 1995), all four vendors here scored excellently with our readers. We surveyed subscribers at random, asking them to rate manufacturers they had used in four key areas: satisfaction with their printers in overall reliability, repair experience, technical support, and number of repairs needed in the first 12 months of use. Canon, Epson, and HP all received A grades, indicating that their ratings in each category were above average. Lexmark received a B, rated above average in every category but first-year repairs, where it earned a creditable average rating.

THE FINAL DECISION

To help you sort out each product's strengths and shortcomings, we've filled out a report card for each printer, grading on output quality, ease of use, speed, cost of operation, and warranty and support. But you will win with any of these printers. With their overall high-quality output, ease of use, good paper handling, and reasonable purchase price, you might find it hard to choose among these ten ink jets, but in no case will you find a loser.

HP DeskJet 682C

Among the color ink jet printers in this review, the six four-color units deliver fine overall output quality, while the four three-color printers will suffice for users on a stricter budget.

The best of the best is the just-released HP DeskJet 682C. For about $330 on the street, you get a four-color design that delivers some of the best black-and-white output and consistently above-average color, even on plain paper. Its color photos on glossy paper were among the best we saw, and cost per page for color pages was lower than the average for the group. What clinches our Editors' Choice is the 682C's ability to print on fanfold paper, allowing you to create colorful banners—the first and only ink jet to offer this capability. With the included PrintPaks and Disney art project software, you have a winning home bundle. Some dealers will sell the same printer, minus the software, as the DeskJet 680C for around $310.

Two products merit honorable mention. Users with a SOHO bent should consider the HP DeskJet 820Cse ($390), which delivers the best text output of the group and arguably the best color output. It's also among the fastest printers we tested. For the very best photographic output, the Epson Stylus Color II ($450) delivers an unsurpassed 720-dpi graphics mode, though you'll need to use the company's special 720-dpi paper.

The Canon BJC-610 ($470) and Lexmark Color Jetprinter 2070 ($400) also produced some superb color output during our runs.

Given how inexpensive four-color ink jets have become, we don't recommend a three-color model. Still, there's nothing wrong with the quality of the Canon BJC-210 ($240), Epson Stylus Color IIs ($230), HP DeskJet 600C ($250), and Lexmark Color Jetprinter 1020 ($200).

Our Contributors BRUCE BROWN is a contributing editor and DAVID R. LAMBERT is an assistant copy editor of *PC Magazine*. JAMIE M. BSALES was the associate editor in charge of this story, and DENIS TOM was the project leader.

Canon Computer Systems Inc.

Canon BJC-210

ALL REVIEWS BY BRUCE BROWN

If funds are tight and you must settle for a low-cost three-color ink jet printer, the Canon BJC-210 is a fine choice. It lists at $259, with an estimated street price of $240. This unit gets a leg up on the other units we reviewed partly because of Canon's unique user-aware packaging and documentation but also because of the company's class-leading service and support policies. With acceptable (but not great) quality and speed, plus Canon's excellent family-oriented software, this printer is a good bet.

The smallest of all printers reviewed here, the Canon BJC-210 has a maximum graphics resolution of 720 by 360 and a 100-sheet paper tray.

Users will find Canon's 800 support number throughout the enclosed documentation. A complete manual is included, but all you really need to get up and running is the fold-out quick-start guide. Once you've installed the printer software, a full-color online manual is ready to explain and guide you through just about any printer problem or project you may face. Canon's aggressive commitment to user support will be reassuring to the most novice buyers.

Canon Creative for Windows, a collection of graphics software with a cartoonlike main menu screen, comes with all of Canon's home printers. The collection's components include Hallmark Connections software (from Micrographx) for making greeting cards, Crayola Art coloring books, and modules for creating cross-stitch patterns, stickers and labels, and personalized stationery.

Canon's ink jet trio: the BJC-4100, BJC-210, and BJC-610.

REPORT CARD	
Canon BJC-210	
Output quality	B
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	A

Canon sells a variety of special papers for its ink jet printers, including transfer paper that you can use to create custom T-shirts designed with your own graphics, drawings, or scanned-in photos.

The BJC-210's overall print quality was its weakest factor. Print-outs showed slightly fuzzy text, a little banding in monochrome graphics printing, less-dense color than most of the other printers produced, and visible dots; photo reproduction was relatively grainy-looking. It's easy to be picky when other printers do a much better job, but this printer is fine for draft work and certainly acceptable for purely home use.

Black-ink cartridges cost $25 and color cartridges cost $35. Canon conservatively rates the BJC-210 at 5 cents per page with 5 percent black coverage and at about 18 cents with 15 percent color coverage. But our drain testing found costs to be closer to 2 cents per page for black (the lowest page cost in this group) and a dime for color pages.

Most attractive is Canon's combination of a two-year warranty with toll-free, live technical support available daily from 6:00 A.M. to midnight (eastern time). If the printer fails at any time during the warranty period, Canon will replace it for free and pay for round-trip shipping, a reassuring benefit that is matched by Lexmark but costs extra with Hewlett-Packard and is not available from Epson.

A four-color printer offers added convenience and higher output quality, but the Canon BJC-210 is a solid choice for a family on a budget.

HOME PRINTERS

How to Read the Report Cards

For home users, the most important factor in choosing an ink jet printer (after perhaps price) is output quality. But typical customers also report a number of other concerns. Ease of use is important, as are the cost of operation and the manufacturer's warranty policy. In our report cards, we rate each printer on the five most important decision points and assign it a grade—from A, which indicates* excellent, *to E for* unacceptable *—based on the factors described here.

To gauge **output quality,** we had a panel of *PC Magazine* staffers examine various samples from each printer. The panelists worked individually and were not told which printer had produced each sample. They viewed monochrome text output, gray-scale output (graphics and a black-and-white photo), color graphics (a child's drawing and a business pie chart), and color photos. All of these were printed on plain copier paper and ink jet paper; the color photo was also printed on glossy stock.

To arrive at a grade for **ease of use,** we considered factors such as the printer's setup routine and paper-handling capabilities. A an A indicates clear, well-illustrated documentation and straightforward software installation. We also evaluated how user-friendly the included printing utilities were and the ease of replacing empty ink cartridges.

The **speed** grade reflects how well the printer performed on our three speed tests, which involved printing a plain text document, a newsletter page, and a complex page containing text and colored bar charts.

Cost of operation reflects the unit's probable running costs in comparison with its peers. A high grade indicates long-life ink cartridges and a relatively low cost per page, both for black-and-white and color output.

The **warranty and support** grade reflects a vendor's support policies. An A indicates a generous, no-cost warranty as well as a liberal exchange policy should a unit need service.

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Canon Computer Systems Inc.

Canon BJC-4100

Canon's midrange home printer, the BJC-4100, can also perform acceptably for small-office or home office use. The unit has the same top-ranked packaging, software, and service and support as the Canon BJC-210, but the four-color BJC-4100 has consistently better output than the other Canons. The BJC-4100, with a $349 list price and a $330 street price, will cost you about $90 more than the BJC-210, but it's worth the increase.

REPORT CARD	
Canon BJC-4100	
Output quality	B
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	A

Midsized at 11.5 by 16 by 19.5 inches (HWD), the BJC-4100 has the same 720-by-360 maximum graphics resolution and 100-sheet paper capacity as the BJC-210. Canon also packs the versatile Canon Creative for Windows software with this printer. Setup and configuration are a breeze with the BJC-4100's documentation and user aids, including its foolproof software.

Output samples showed the BJC-4100 to be a clear step up from the BJC-210, but still average compared with the full field of printers we reviewed. Black text had only minor fuzziness, but monochrome and color photograph reproduction each showed minor banding. In all cases, print quality improved significantly with better-grade paper, so if you buy this printer we recommend spending the extra money for premium-grade plain paper.

You can outfit the BJC-4100 with different types of ink cartridges. An optional $29 high-capacity all-black cartridge is rated at a competitive 3 cents per 5-percent-black page. The standard two-part cartridge holds a $7.40 black replacement tank and a $21 color replacement. Color is rated at 13.5 cents per 15 percent page, and our drain tests peg the cost at around 12 cents—on a par with the rest of the field.

The Canon BJC-4100 is a good all-round printer. To Boot, you get Canon's generous customer service and warranty programs. But it's got some tough competitors, especially the HP DeskJet 682C, which delivers better overall print quality and the ability to handle fanfold paper for the same street price.

Canon Computer Systems Inc.

Canon BJC-610

Canon's highest-quality home printer, the $499 BJC-610 ($470 street), is slower than the less-expensive BJC-210 and BJC-4100, but its color and graphics printing quality is worth the wait. Add to that a low cost per printed page and Canon's superior setup and reference aids, and the BJC-610 is a contender.

REPORT CARD	
Canon BJC-610	
Output quality	B
Ease of use	A
Speed	C
Cost of operation	A
Warranty and support	A

With 192 color printing jets, the BJC-610 can print graphics at a resolution of up to 720 by 720 dpi. Color graphics samples had reasonably dense and true colors on coated ink jet stock, but photograph samples were only average, exhibiting minor banding and slightly fuzzy images even on expensive

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stock. Text printing on standard copier paper was quite good, and monochrome graphics showed very little banding.

The BJC-610 uses separate cartridges for the four ink colors (cyan, magenta, yellow, and black); other four-color printers have separate black cartridges but combine other colors into single cartridges. Replacement black-ink tanks cost $12.25 each, and the smaller tanks are $8 apiece. Canon rates the printer at 2.5 cents per 5-percent-black page and 7 cents for each 15-percent-color page, figures closely matched by our drain test results of 3 cents for black and 7 cents for color.

Canon includes the versatile Canon Creative for Windows software package with the BJC-610. Also welcome is a standard two-year warranty and free overnight exchange of defective units.

The Canon BJC-610's top warranty, easy setup procedure, and low printing costs are its best features compared with competing printers like the Epson Stylus Color II and HP DeskJet 820Cse. These Epson and HP printers both have faster print speeds and equal or better print quality, but the BJC-610 is still worth a closer look.

Epson America Inc.

Stylus Color II

Of the ten printers reviewed here, Epson's $649 Stylus Color II ($450 street price) does the best job of reproducing color photographs on mid-priced paper. This four-color ink jet printer works with plain paper, but you'll be most impressed with the results if you print on Epson's own 720-dpi paper ($14.49 for 100 sheets). This strong suit has a dark side, however: Printing on plain paper or on any ink jet stock not specifically Epson-branded produces average quality at best.

Compatible with the Macintosh as well, the Stylus Color II is the only choice among the tested printers for households with both a PC and a Mac. It has a maximum graphics resolution of 720 by 720 dpi, though you must use the Epson paper rated for this resolution. No software comes with the printer, but a coupon is included for free copies of Storm's E-Z Photo 1.1 (for photo scanning and image editing) and Sierra On-Line's Print Artist 3.0.

You'll find separate documentation for installing the printer for use with Windows 95 and Macintosh systems. In addition to a complete manual, there are also instructions

REPORT CARD

Epson Stylus Color II	
Output quality	A
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	B

Epson's three-color Stylus Color IIs and four-color Stylus Color II.

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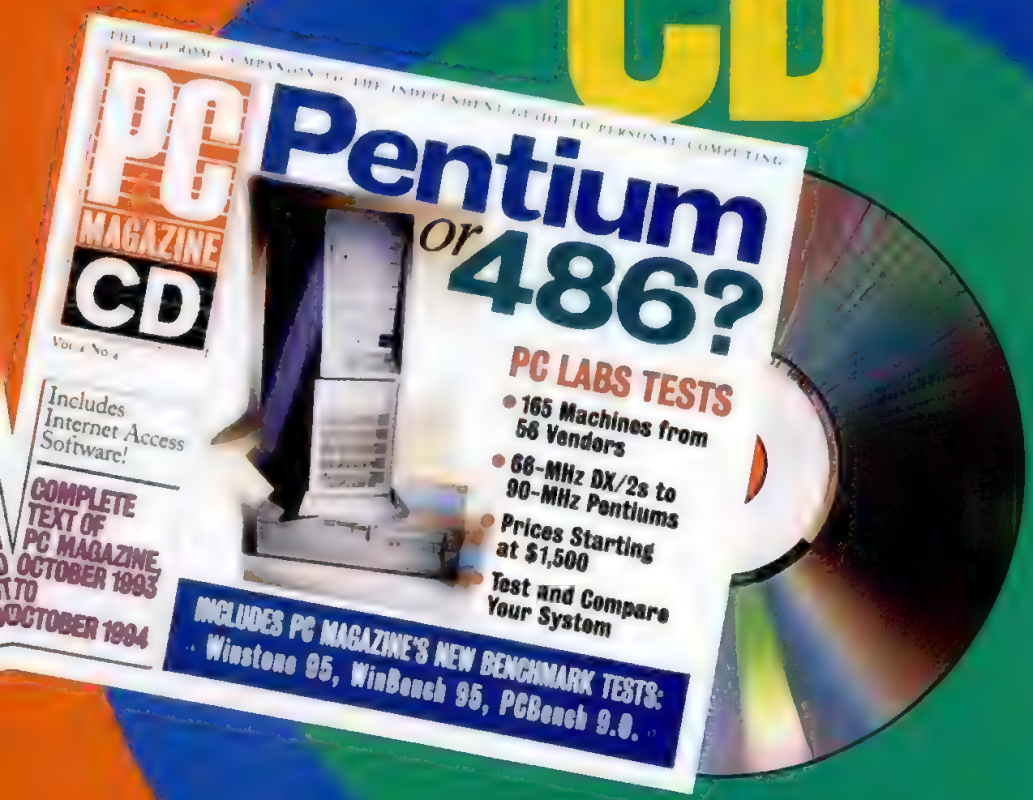

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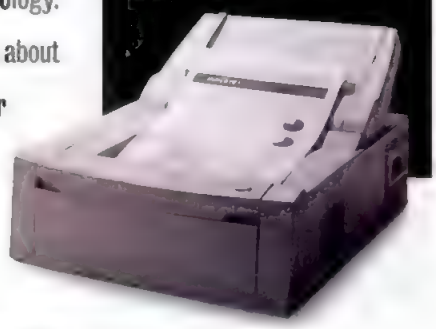

CIRCUIT CITY COMPUSA STAPLES

*Estimated street price. †Some restrictions apply to the overnight replacement warranty. For more information via fax, call NEC FastFacts™ at 1-800-366-0476 and request document #778600. SuperScript, FastFacts and See, Hear and Feel the Difference are trademarks of NEC Technologies, Inc. All other trademarks and registered marks are property of their respective owners. ©1996 NEC Technologies, Inc.

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and labels on the printer itself.

The ample user aids help you with setup, and the tabbed-page printer driver applet simplifies configuration for print jobs. Epson's two-year warranty is backed by toll-free tech support Monday through Friday from 9:00 A.M. to 9:00 P.M. eastern time, but it does not yet offer overnight exchange for defective units as do the other vendors.

Text printing on plain paper is only average, with noticeable ink jet fuzziness. Black-and-white samples of a newsletter printed with default settings on coated stock produced somewhat light and grainy photo images but strikingly sharp text. Color graphics print-outs had slight banding but consistently deep colors. Color photos printed on plain paper and on glossy stock were only average, but the output on Epson's 720-dpi paper was exceptional.

Rated at 4 cents per 5-percent-black page and 12 cents per 15-percent-color page, the Stylus Color II came in slightly above that on our drain tests (5 cents and 15 cents), making it slightly more expensive to run than most other ink jets. Black-ink cartridges cost $25, and color cartridges cost $38.

Family members who enjoy photography or printing photo files will appreciate the Epson Stylus Color II for quality output at a reasonable cost.

Assessing the Output

CANON BJC-210 *Text shows tell-tale ink jet fuzziness on plain paper. The clown is printed on medium-grade stock, because BJC-210 images didn't take well to glossy paper.*

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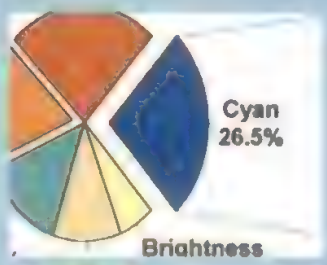

CANON BJC-4100 *The pie chart (on ink jet paper) shows only minor banding. Like the BJC-210, this Canon unit produced better photo output on medium rather than high-grade paper.*

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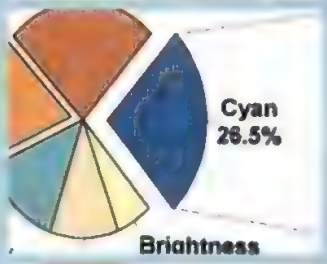

CANON BJC-610 *The text on copier paper is good, but the image shows banding—as does the clown. Pie chart colors were fairly consistent and reasonably dense on coated stock.*

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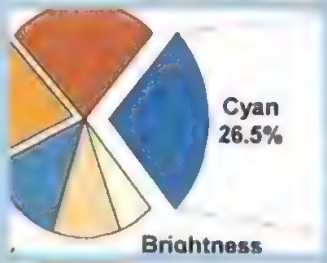

EPSON STYLUS COLOR II *Plain-paper text and graphics show jaggies and weak resolution, but the color chart is excellent. The photo, printed on Epson's special 720-dpi stock, is superb.*

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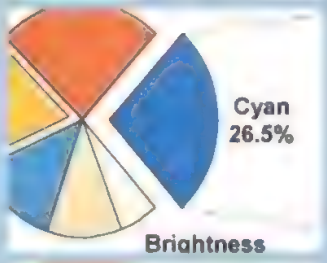

EPSON STYLUS COLOR IIS *Gray-scale print samples were decent, with only slight fuzz. The graphic is consistent with good color depth for a three-color printer. The clown is on Epson's special paper.*

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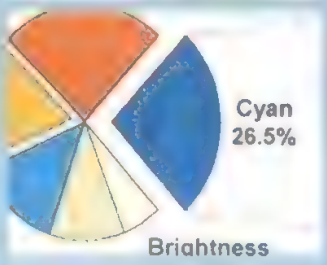


It's also suited for home-office duty or for making low-cost proofs in a graphics art environment. If you use only Epson's premium papers, you'll never complain about print quality, though the printer's middling quality on plain paper stock makes its relatively high purchase price harder to accept.

Epson America Inc.

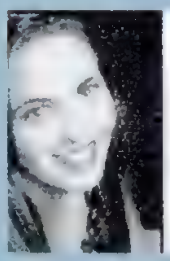
Epson Stylus Color IIs

Though the names are close, the $349 Epson Stylus Color IIs ($230 street) is not in the same league as its more expensive sibling, the Stylus Color II. It produces reasonable output for a printer in this price range and is a good choice for the budget-conscious buyer.

The Stylus Color IIs is a three-color printer and you must switch between black and color cartridges for monochrome and color jobs, and blacks on color pages will have a somewhat muddy appearance. Slower than its four-color sibling, it has a maximum resolution of 360 dpi, but because it uses smaller-than-usual dots on a 720- by 720-dot grid, this low-end printer can print fine images.

The IIs performs best on Epson's special stock. Surprisingly, on our print samples it outperformed the more ex-

HP DESKJET 600C *Black-and-white samples are exceptional, but colors on the pie chart came out muted and inaccurate. The photo, though a little dark at the default setting, is good for a printer in this price range.*



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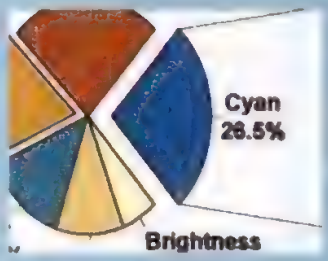
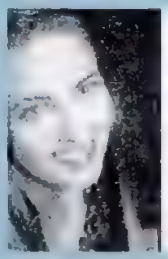


HP DESKJET 682C *Black text is clear and sharp, and gray-scale images are consistent. Color graphics are true, with a clear focus. The clown photo had a higher resolution than most.*



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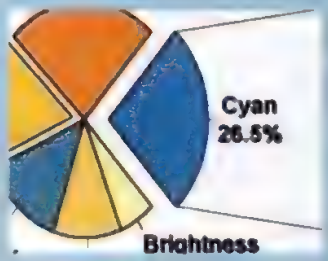

HP DESKJET 820CSE *Text is excellent—near laser quality. Our chart's colors are true and maintain good separation. The clown on glossy paper is rich with no muddiness—the best we saw.*

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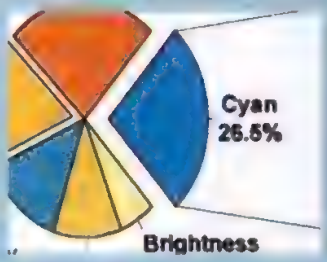

LEXMARK COLOR JETPRINTER 1020 *The text contains some fuzziness. The color graphic has good saturation, but the colors are not very vivid. The glossy clown image is somewhat grainy.*

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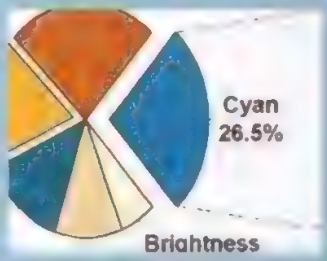
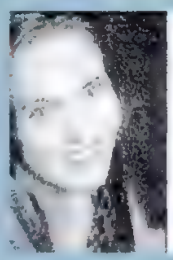


LEXMARK COLOR JETPRINTER 2070 *The black-and-white sample has only minor fuzziness, but there should be none at all. The pie shows some dottiness.*



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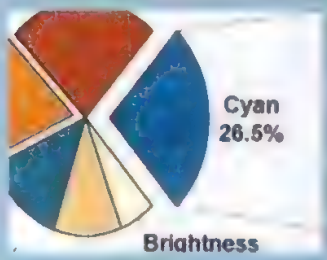


pensive printer on plain paper. Black text on plain paper was a little fuzzy, but the black-and-white graphic sample was significantly above average on plain paper and particularly praiseworthy on special Epson paper. The IIs also does well on color graphics and color photo reproduction, with fairly good output on plain paper and exceptionally clear print on Epson stock.

Cost per page is a weak point. The unit is rated at 5 cents per page for 5-percent-black coverage, but our drain testing indicated a cost closer to 6 cents per page—the highest cost in this roundup. Printing in color, which Epson rates at 12 cents per 15 percent page, calculated to a high 22 cents on drain tests.

Overall, the Epson Stylus Color IIs is a reasonably capable family printer. It produces good output for a three-color printer, though its low purchase price could be offset by higher costs per page for families that use it often.

REPORT CARD

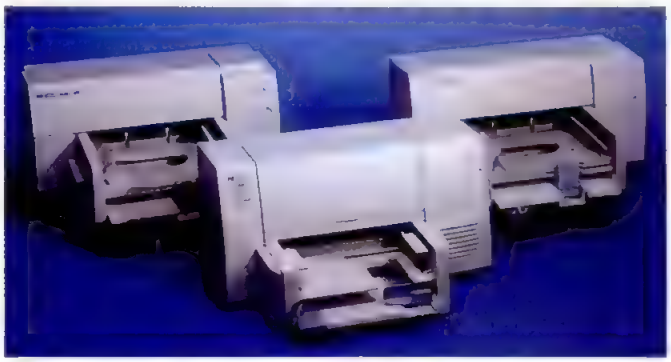
Epson Stylus Color IIs

Output quality	B
Ease of use	A
Speed	C
Cost of operation	C
Warranty and support	A

Hewlett-Packard Co.

HP DeskJet 600C

Hewlett-Packard's HP DeskJet 600C ($309 list price, $250 street) is the printer manufacturing giant's entry-level three-color ink jet model. Particularly good when printing text on plain paper and for printing black-and-white graphics images, the 600C is less adroit in producing color graphics and



A fine threesome: HP's DeskJet 682C, 820Cse, and 600C.

SUMMARY OF FEATURES

Home Printers

■ YES ■ NO	Canon Computer Systems Inc. **Canon BJC-210**	Canon Computer Systems Inc. **Canon BJC-4100**	Canon Computer Systems Inc. **Canon BJC-610**	Epson America Inc. **Epson Stylus Color IIs**	Epson America Inc. **Epson Stylus Color II**	Hewlett-Packard Co. **HP DeskJet 600C**	PC MAGAZINE EDITORS' CHOICE Hewlett-Packard Co. **HP DeskJet 682C**	Hewlett-Packard Co. **HP DeskJet 820Cse**	Lexmark International **Lexmark Color Jetprinter 1020**	Lexmark International **Lexmark Color Jetprinter 2070**
Estimated street price	$240	$330	$470	$230	$450	$250	$330	$400	$200	$400
Dimensions with paper trays extended (HWD, in inches)	10.3 x 13.6 x 10.5	11.5 x 16.0 x 19.5	11.0 x 14.4 x 22.8	10.3 x 15.3 x 20.6	14.5 x 17.0 x 24.5	7.5 x 17.0 x 17.3	7.8 x 17.0 x 16.0	8.9 x 17.2 x 16.0	11.7 x 14.5 x 9.4	13.5 x 17.0 x 20.5
Jets for monochrome/color	64, 48	64, 72	64, 192	64, 60	64, 60	48, 48	48, 50	300, 192	52, 48	104, 96
Maximum color graphics resolution (dpi)	720 x 360	720 x 360	720 x 720	360 x 360	720 x 720	600 x 300	600 x 300	600 x 300	600 x 300	600 x 600
Parallel/serial port	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Macintosh-compatible	■	■	■	■	■	■	■	■	■	■
Maximum paper width (inches)	9.5	9.5	9.5	8.5	8.5	8.5	8.5	8.5	8.5	9.0
Paper input capacity (sheets)	100	100	100	100	100	100	100	150	100	150
Prints on card stock/overhead transparencies	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Prints on legal paper/envelopes	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Windows 95 driver included	■	■	■	■	■	■	■	■	■	■
Low-ink alert (hardware/software)	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Application software included	Canon Creative for Windows (Crayola Art, Hallmark Connections)	Canon Creative for Windows (Crayola Art, Hallmark Connections)	Canon Creative for Windows (Crayola Art, Hallmark Connections)	Print Artist 3.0, Storm EZ-Photo 1.1	Print Artist 3.0, Storm EZ-Photo 1.1	None	HP Home Project Kit (includes PrintPaks Family Fun Kit)	Microsoft Publisher for Windows 95	CorelDraw 3.0	CorelDraw 4.0
3-color or 4-color printing	3-color	4-color	4-color	3-color	4-color	3-color	4-color	4-color	3-color	4-color
Cost per high-capacity black-ink cartridge	$25.00	$29.00	$12.25 (tank replacement)	$25.00	$25.00	$32.95	$32.95	$32.95	$32.95	$35.95
Cost per color cartridge	$35.00	$21.00	$8 (tank replacement)	$38.00	$38.00	$34.95	$34.95	$35.95	$38.95	$39.95
Vendor's rated cost per page:										
With 5% black coverage	5 cents	3 cents	2.5 cents	4.5 cents	4 cents	4 cents	3 cents	3 cents	3 cents	3 cents
With 15% color coverage	17.5 cents	13.5 cents	7 cents	12 cents	12 cents	12 cents	12 cents	8 cents	19 cents	17 cents
Warranty (parts and labor)	2 years	2 years	2 years	2 years	2 years	3 years	1 year	1 year	2 years	2 years
Overnight exchange of defective unit	■	■	■	■	■	Optional ($49)	Optional ($49)	Optional ($49)	■	■
Toll-free technical support	■	■	■	■	■	■	■	■	■	■
Technical-support hours (eastern time)	6:00 A.M.–12:00 midnight M–Sat.	6:00 A.M.–12:00 midnight M–Sat.	6:00 A.M.–12:00 midnight M–Sat.	9:00–9:00 M–F	9:00–9:00 M–F	8:00 A.M.–12:00 midnight M–F, 11:00–6:00 Sat.	8:00 A.M.–12:00 midnight M–F, 11:00–6:00 Sat.	8:00 A.M.–12:00 midnight M–F, 11:00–6:00 Sat.	10:00–7:00 M–F	10:00–7:00 M–F

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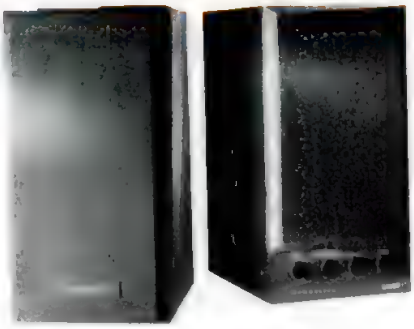

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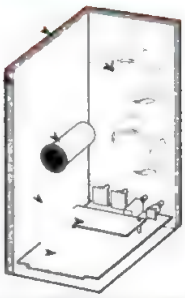

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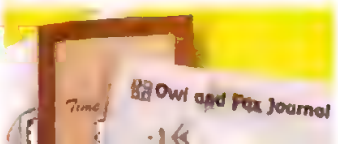

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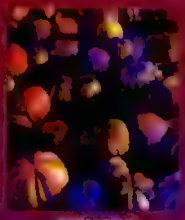
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BENCHMARK TESTS

Color Ink Jet Printers

The costlier ink jet printers for home use aren't necessarily faster. But you do get better print quality when you buy a vendor's higher-priced printers.

What the Numbers Mean

The HP DeskJet 820Cse, from Hewlett-Packard, and the Color Jetprinter 2070, from Lexmark International, were the fastest units overall in our speed testing. The HP DeskJet 820Cse is the first HP printer to use the company's new Printing Performance Architecture. This is an integrated cross-platform firmware and software design that effectively doubles ink jet performance and directly benefits from HP's work with Microsoft on the Windows 95 printing subsystem. The Color Jetprinter 2070 incorporates Lexmark's newest host-based driver, so many time-consuming processes are achieved using the computer's processor and RAM. Lexmark has also doubled the number of print heads from earlier models, increased firing frequency by 40 percent, and speeded up paper-feeding, all of which combine to make printing faster.

The Canon BJC-610 was among the slowest on our speed tests. But with 192 jets, the BJC-610 gives up printing speed in favor of higher-quality output.

Results on our Ink Drain tests are affected by the quantity of ink in the tanks and the way in which ink is squirted onto the page. We used these results to calculate the per-page costs cited in the reviews.

How We Tested

We tested all printers on an HP Vectra XU 5/90—a 90-MHz Pentium with 16MB of RAM and a 1GB hard disk that was running Windows 95.

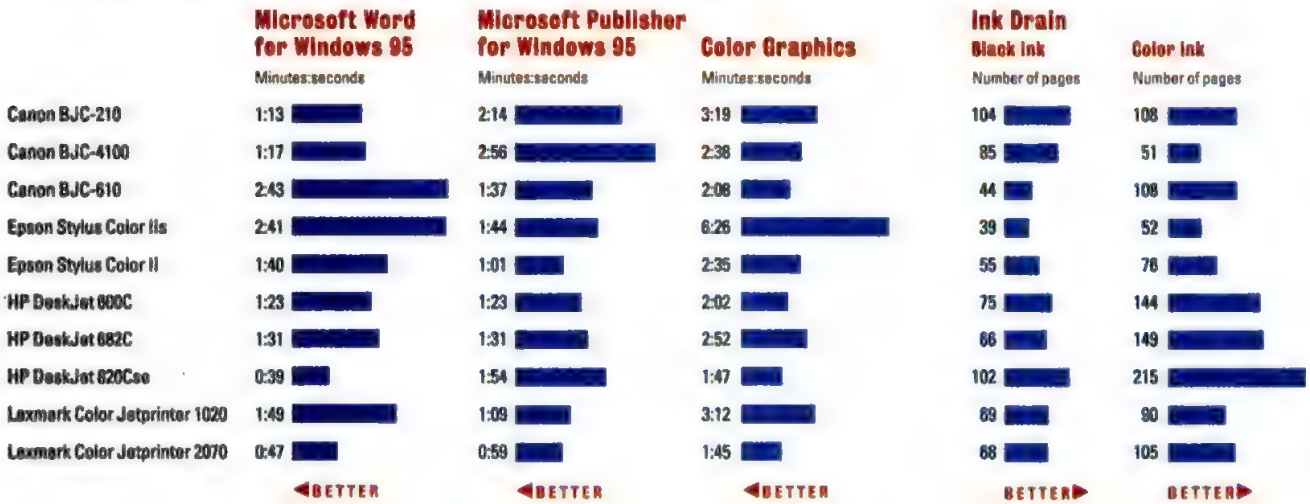
We timed the speed tests with a stopwatch and ran each one twice, after defragging and rebooting the computer. If the test results differed by more than 5 percent, we ran the test again.

The **Microsoft Word for Windows 95** test measures a printer's speed in producing a two-page text document created in Microsoft Word for Windows 7.0. The document used a variety of fonts and text features.

The **Microsoft Publisher for Windows 95** test measures a printer's speed in producing a monochrome one-page newsletter that contains a gray-scale photograph, a gradient-fill background, black page elements, and text.

The **Color Graphics** test measures a printer's speed in producing a one-page document that contains both black and color text, multicolor charts, color-gradient bars, and the PC Magazine Labs logo.

The **Ink Drain** tests measure how many pages you can expect from a printer's color and black cartridges wear out. We created pages of solid bars that covered 50 percent of an 8.5- by 11-inch page. For each test we started with a new cartridge that we properly installed and cleaned or aligned using the manufacturer's recommended procedures. We printed pages continuously until the bars began to streak and fail noticeably.—*Analysis written by Bruce Brown*



color photo output. Still, this unit is a safe bet for families who want a budget printer from the biggest name in the business.

Maximum graphics resolution for the 600C is 600 by 300 dpi, but you'll need high-quality paper to use that mode. The paper input tray holds 100 sheets and also handles envelopes and a variety of paper stock. HP includes its complete and well-organized printer software driver but none of the extra family-fun applets that users have come to expect in this market segment.

The documentation is comprehensive, although you won't find the same level of user aids as Canon or Epson provides. Setup is straightforward, but should you need help, you'll have to make a toll call to get live HP tech support (there is an 800 number that offers recorded tips and a fax-back system for common problems).

Text samples printed on plain paper had crisp, clear letter and were rated the highest of the ten printers reviewed here. Monochrome graphics samples were also good, with no visible banding. Color reproduction in graphics printing appeared to be somewhat off, even though we tried several different ink cartridges. Colors

REPORT CARD

HP DeskJet 600C

Output quality	B
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	B

were more accurate (though a little dark at default settings) on our color photograph print samples. In all cases, using special coated stock yielded much better results.

Our ink drain tests pegged costs per page for the 600C at a competitive 4 cents for 5-percent-black coverage and just 7 cents for 15-percent-color—even lower than HP's estimate of 12 cents. Black-ink cartridges cost $32.95, and color cartridges cost $34.95. The 600C comes with a generous three-year warranty. A $49 option buys HP's Express Exchange option for free unit-swapping if your printer fails during the warranty period.

A safe bet, the HP DeskJet 600C is a competent printer. Though not as good at printing color as the Epson Stylus Color IIs and the Lexmark Color Jetprinter 1020 (three-color printers), no other printer in this roundup did a better job with black text.

Hewlett- Packard Co.

HP DeskJet 682C

PC MAGAZINE EDITORS' CHOICE

Hewlett Packard's four-color HP DeskJet 682C will cause a major ripple in the ink jet community. because it is the first ink jet printer that can print on fanfold paper. Now you can make colorful banners that are 20 feet long or a spreadsheet just as wide. With a highly competitive street price of $330, the 682C is a bargain and is a step up from the HP DeskJet 600C.

To print on fanfold paper, simply move one lever on the paper-input tray and put in up to 20 sheets. The printer's mechanical parts hold the paper so that output stays consistent.

Output quality is another hot feature of HP's DeskJet 682C. Black text is clear and sharp, and black-and-white images are good. Color output on coated stock showed rich, true colors, and photos retained detail well.

The 682C comes with the HP Home Project Kit, which includes Disney's Mickey and Friends Print Studio CD-ROM and the Family Fun Kit CD-ROM by PrintPaks. Sample paper stock is also included.

REPORT CARD

HP DeskJet 682C

Output quality	A
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	B

HP rates the 682C's cost per page at around 3 cents for 5-percent-black printing and 12 cents for printing with 15 percent color. In drain testing we found the cost to be a nickel for black but a competitive 7 cents for color. The 682C uses the same cartridges as the 600C—the cost is $32.95 for black and $34.95 for color.

The standard warranty for the DeskJet 682C is one year, and a $49 option extends coverage for three years and includes HP's Express Exchange program. Again, you must make a toll call to get live support.

With great paper handling, terrific output, and a low operating cost, the HP DeskJet 682C is the printer of choice.

Hewlett-Packard Co.

HP DeskJet 820Cse

Hewlett Packard's four-color HP DeskJet 820Cse ($486 list price, $400 street) is the best in its class. It's fast, produces excellent output, and has the lowest cost of operation of the tested printers. If you'll be using your home printer for business as well as family use, seriously consider the DeskJet 820Cse.

The 820Cse uses the same case and print engine as its 800-series stablemates, the SOHO-oriented DeskJet 855 and 855Cse. The extra-capacity paper-input tray holds 150 sheets (equaled in this roundup only by the Lexmark Color Jetprinter 2070). The top graphics resolution is 600 by 600 dpi in black and 600 by 300 in color. HP includes a desktop publishing package, Microsoft Publisher for Windows 95, driving home the point that this is a more serious-minded home ink jet.

REPORT CARD

HP DeskJet 820Cse

Output quality	A
Ease of use	A
Speed	A
Cost of operation	A
Warranty and support	B

Like all the other printers in this roundup, the 820Cse does its best work on special papers. Unlike the others, though, it does a fine job on plain paper, as well. Monochrome and color graphics and even color photographs looked good on plain paper, without banding, over-sized dots, or off colors. The fastest printer in this review (tied with the Lexmark Color Jetprinter 2070), the 820Cse does it all.

HP rates the 820Cse at 3 cents per 5-percent-black page and 8 cents per 15-percent-color page, but our drain testing proved it to be even better, averaging 3 cents for black and a class-leading 5 cents for color printing. Replacement ink cartridges, the same cartridges used in the other 800-series printers, cost $32.95 for black and $35.95 for color ink.

For $60, you can extend the standard one-year warranty for three-year coverage and Express Exchange service. Alas, live technical support requires a toll call.

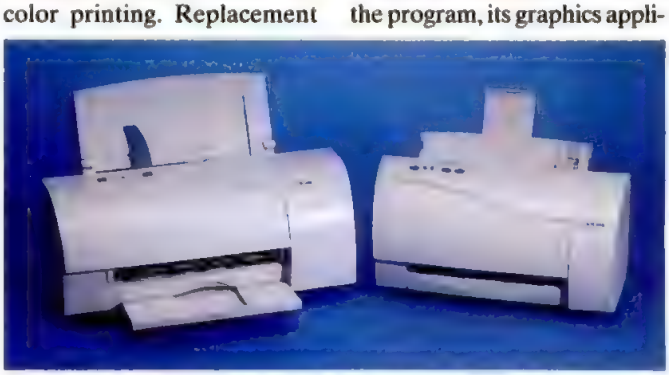
The HP DeskJet 820Cse is fast, cost-effective, and prints consistently high-quality output in all modes and on all types of paper. If you aren't enamored with banner printing or Disney freebies, then this is the printer for you.

Lexmark International Inc.

Lexmark Color Jetprinter 1020

The least expensive home printer in this review ($249 list price, $200 street), the three-color Lexmark Color Jetprinter 1020 isn't very fast, but setup and operation are simple, and print quality is acceptable. If your budget is tight, be sure to look at this unit.

The compact Color Jetprinter 1020 delivers 600- by 300-dpi resolution on special stock, though for most jobs its 300-dpi mode will suffice. CorelDraw 3.0 is included, and while this is an older version of the program, its graphics appli-



High and low: Lexmark's Jetprinter 1020 and Jetprinter 2070.

Low-Cost Lasers: Better Quality, No Color

Color ink jet printers are a wonderful choice for all-purpose family use, but for black-and-white documents, even the best ink jets still can't match the crispness of a laser printer. So if you need a home printer primarily for business-quality monochrome printing—say, for term papers, newsletters that will be photocopied, or documents for work—one of the low-cost lasers printers now on the market might be a better choice.

Personal laser printers are affordable (there are at least a half-dozen priced around $500), compact, and quiet, and they cost less to operate than ink jets—around 2 cents for a typical text page versus 5 cents for the average ink jet monochrome page. All five of the suitable low-cost lasers we reviewed offer simple setup and user-friendly software that adds special touches, such as background watermarks on pages and the ability to produce booklets and thumbnails of documents.

Since color laser printing won't come to the home this century (unless your mailbox says B. Gates and you can shell out anywhere from $5,000 to $12,000), you have to be certain you want to walk away from the color capability an ink jet delivers. Or you could buy one of each.

One of the newest entries in this fast-growing market segment is the **NEC SuperScript 860**, from NEC Technologies (Boxborough, MA; 800-632-4636). This printer raises the bar for home and SOHO lasers, delivering an impressive 8-page-per-minute (ppm) rated engine speed (competitors in this class have speeds of 4 and 6 pages per minute) and true 600-dpi resolution. NEC's edge-sharpening algorithm and super-fine toner particles mean text and graphics that are clean and precise. The big news, though, is behind the scenes. The SuperScript uses the recently released Adobe PrintGear printer description language (the instruction set that translates data from the host PC into the text and images you want on paper). Adobe claims that the language is optimized for the type of print jobs SOHO users need and that it costs less for manufacturers to add than either of the competing languages, PCL or PostScript. At just $500 on the street, the 8-ppm SuperScript is a compelling choice.

It has to be if it's going to compete with the best-selling printer the world has ever known, the **HP LaserJet 5L** ($480 street price), from Hewlett-Packard (Santa Clara, CA; 800-333-1917). The LaserJet 5L was a *PC Magazine* Editors' Choice honoree in our most recent roundup of personal laser printers (November 7, 1995). It has a slower engine than some others (just 4 ppm), but its 600- by 600-dpi capability is unsurpassed, and its compact size (about 9 by 13 by 12, HWD) makes it an ideal choice for cramped spaces.

If space and money are really tight, consider the **TI microLaser WIN/4** ($380 street price), from Texas Instruments (Temple, TX; 800-848-3927). The smallest printer of this small group, measuring just 8 by 12 by 11 inches and weighing a mere 11 pounds, the microLaser looks like an oversized toaster. A 600-dpi, 4-ppm printer, the microLaser uses Microsoft Windows Printing System language. That means it relies on the host PC to do most of the processing, so you'll need a 486 or better PC with at least 8MB of RAM to run it.

The **Panasonic KX-P6500** ($500 street price; Secaucus, NJ; 800-742-8086) has a 600-dpi laser engine and is rated at 6 ppm. Unusual in shape, the KX-P6500 saves desk space by standing upright, needing a space only 5 inches wide by 15 inches deep at its base. Like the microLaser, the KX-P6500 relies on the host PC's resources to print from Windows.

One of the best bargains around is from Okidata (Mount Laurel, NJ; 800-654-3282): the **Okidata OL600e**, at just $400 on the street. Its 6-ppm engine produces 600 dpi using LED (light-emitting diode) technology instead of a laser beam, but you won't notice the difference in output. If you want laser quality but are watching every penny, the Okidata should fit the bill.—*BB*

cations will likely be new and useful to most home users.

Lexmark's GDI interface is a pleasure to use. You can control all printer operations except page-feeding from your PC and, via a bidirectional parallel port and printer cable, you can view the progress of current print jobs and also observe the ink level in the current cartridge. The driver also includes voice prompts, using a pleasant female voice that plays through your computer speaker to alert you to low ink status or to let you know when you're out of paper.

Black text printed on plain paper looked a little fuzzy, and monochrome graphics samples had minor but visible banding. The color in color graphics print samples was not very vivid and somewhat muted. The big surprise, given the unit's three-color print head, was the high quality attained when we printed our color photograph sample on expensive glossy stock. This print was less focused on plain and coated stock. Investing in upgraded plain-paper stock for everyday printing will pay off in the long run with this printer.

Lexmark rates the Jetprinter 1020 at a reasonable 3 cents per page for 5-percent-black coverage and a high 19 cents for 15-percent-color

REPORT CARD

Lexmark Color Jetprinter 1020

Output quality	B
Ease of use	A
Speed	B
Cost of operation	B
Warranty and support	B

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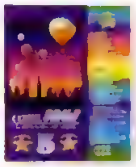

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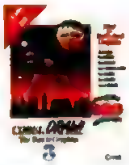

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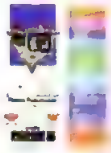

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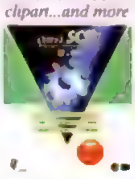

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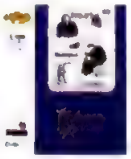

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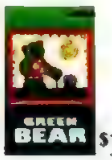

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coverage; our drain tests put it at a high 5 cents for black and a reasonable 13 cents for color. Go figure. Replacement cartridges cost $32.95 for black and $38.95 for color ink.

Lexmark offers a generous warranty program, with two-year coverage and a no-cost overnight-exchange policy should your printer fail. The only downside is that live technical support, as with HP, requires a toll call.

The Lexmark Color Jetprinter 1020 is a good choice if your budget is limited and you want the most for your money. On a par with the Canon BJC-210, the Jetprinter 1020's lower price and slightly better print quality gives it the edge.

Lexmark International Inc.

Lexmark Color Jetprinter 2070

Lexmark's four-color Color Jetprinter 2070 ($549 list price, $400 street) is fast, relatively inexpensive to use, and prints consistently good output. On a par with the Canon BJC-610, Epson Stylus Color II, and HP DeskJet 820Cse, this high-end home printer has few faults.

The Jetprinter 2070 is capable of a 600- by 600-dpi graphics resolution for both monochrome and color printing. It has a 150-sheet paper tray and comes with Corel Draw 4.0, a graphics application collection one step above the set included in the 3.0 Version bundled with the low-cost Color Jetprinter 1020. Setup and installation are thankfully uneventful, with a quick-start guide and thorough documentation, plus tabbed-page print job control software.

REPORT CARD

Lexmark Color Jetprinter 2070

Output quality	A
Ease of use	A
Speed	A
Cost of operation	B
Warranty and support	B

Black-text printing is good, with only minor fuzziness on plain paper, and monochrome graphics samples had barely discernible banding, but were grainy; both monochrome print samples were fine for a home printer. The Jetprinter 2070 did an above-average job printing our color graphics test samples. The output was judged a close second to that of the class-leading HP DeskJet 820Cse. Surprisingly, the 2070's color photo print-out on glossy paper didn't look as good as its cheaper sibling's, though the 2070 had a clear edge on plain paper and coated stock.

Our drain testing resulted in calculated per-page costs of 5 cents for black printing and 11 cents for color, which makes this an affordable unit to run. Replacement ink cartridges cost $35.95 and $39.95 for black and color, respectively.

As with its Color Jetprinter 1020, Lexmark provides a two-year warranty with free exchange in case of failure, but there is no toll-free technical support.

The Lexmark Color Jetprinter 2070 is a fine printer, cost-competitive with the top Canon, Epson, and HP models and faster than both the Canon BJC-610 and the Epson Stylus Color II. Print quality, while very good, didn't quite meet the level set by the HP DeskJet 820Cse in our testing, but it was close enough that most families won't notice or care. □

Tracking Down The Players

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Circle 472 on reader service card

Join Us Online

From May 13 through May 17, join contributing editor Bruce Brown online to discuss home ink jet printers Representatives from the companies whose printers we reviewed in this roundup—Canon, Epson America, Hewlett-Packard, and Lexmark International—will also be on hand to answer your questions. Type GO EDITOR at any CompuServe prompt

Ink Jet Accessories: Dream in Color

Henry Ford could never have envisioned drive-in theaters when he started churning out automobiles. Likewise, the designers of the first color ink jet printers couldn't possibly have anticipated the wide array of accessories that would make these printers ideal for more than just printing pie charts.

To help you and your kids get the most out of your printer, consider the PrintPaks Window Art Kit ($19.95), from PrintPaks (800-774-6860), and Print Shop Deluxe II ($49.95), from Broderbund (800-521-6263). These packages improve on standard banner- and card-making software by adding wild and colorful new crafts you can make with your kids. Create iron-ons, ornaments, refrigerator magnets, and suncatchers without any crayons or markers to clean up.

If you would rather decorate your print-outs with those summer vacation photos, consider the EasyPhoto Reader photo scanner (with software, $250), from Storm/Primax (800-275-5734). About the size of an electric pencil sharpener, the EasyPhoto will have you converting your entire library of photo albums into JPEGs in no time. Simply install the easy-to-use software, plug the scanner into your parallel port, insert a photo, and press the big green Start button.

Those photos and all your other output will look their best when printed on paper specially formulated for ink jet printers. Rexam Graphics (413-536-7800) markets a range of quality stock, including a brand-new line of resin-coated papers designed to keep your colorful graphics from bleeding or fading. And the Paper Direct catalog (800-272-7377) contains a huge assortment of specialty papers: faux marble or granite stock, paper with cool borders, even a handy three-panel pamphlet template complete with punch-out Rolodex card.—*David R. Lambert*

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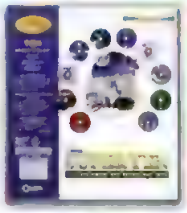

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Coming Up

Online Services

Online services are competing in a fierce new Web-enabled world, but the best still have plenty to offer. In the fight to stay relevant, they are rapidly transforming both their content and the ways they let you connect. We review the major online services—America Online, CompuServe, The Microsoft Network, Prodigy, and Wow!—to find out how easily they let you connect and navigate, what type of user community they offer through forums, chat, and e-mail, and whether the packages are worth the price. We also look at online services in their new role as gateways to the Internet, as providers of Internet content, and as places where you can put up your own Web pages.

Fast Connections

Remember when you thought those 28.8-Kbps modems would give you all the bandwidth you could hope for? These days, with more workers staying home and telecommuting, and with Internet users pouncing on Web sites gilded with graphics, sound, and video, that old analog connection starts to look like a slug. *PC Magazine* looks at the hottest digital technology for hyperspeed connectivity: ISDN (Integrated Services Digital Network). We review six ISDN terminal adapters and provide tips on getting ISDN services from your phone company and Internet service provider. We also give a glimpse of what tomorrow's even fatter pipes promise in ADSL (Asymmetric Digital Subscriber Line), cable modem, and satellite data services.

Network Laser Printers

An integral part of any company's computer landscape is the bevy of shared laser printers that deliver essential hard copy. Matching every workgroup and department with the right printer is no easy chore, however. Printing speeds, duty cycles, and paper-handling abilities vary widely, as do the printers' networking features, functionality, and creature comforts. We test 12 of the best network laser printers—machines that range in speed from 12 pages per minute to a whopping 40 ppm—to help you pick the right one for your needs.

Java and Java Tools

The hottest topic since the Web itself, the coolest way to add dynamic, interactive content to your Web pages—that's Java. But why is it so popular? And just how easy is it to create Java applets? We take a look at the Java language, the Java Development Kit, and two tools that make creating applets easier. We even offer a little home brew—a simple Java applet that animates the *PC Magazine* logo.

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NE—Network Edition.
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What kind of people report their organization for illegally copying software?

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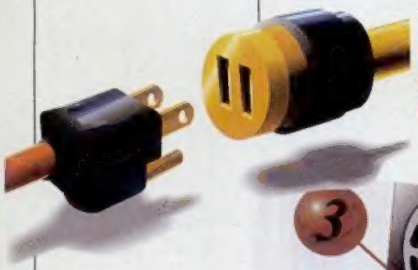
Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Miss Lotus Lonelyhearts

Faithful reader Robert Starkey went to Lotus Word Pro's online help and typed in, "How do I get a date from Organizer?" The answer he got: " You can use one of the following tried-and-true methods to get a date: go to the wine section of the grocery store, ask a friend to the movies, put an ad in the newspaper, take a dance class, write your e-mail address on a bathroom stall, climb a date tree."



This newfangled electricity stuff is so confusin'. Plug ugliness from Quarterdeck (left) and Gateway 2000 (below).

RICHARD TENNANT

"Of course it was a tragic mistake, Mr. Hamlin. Someone inadvertently left the Mr. Potato Head game running on the operating-room monitor."

Finally, Psychic Software

"Combined with Caller ID, this powerful feature lets you know who's calling and what you talked about BEFORE you answer."—OCTuS PTA AD

Never scoop cat litter again... Computer technology creates the only self-cleaning litter box!

What will they think of next? This gadget looks as though it could double as an ink jet printer. (Comtrad Industries ad.)

Next Stop: Documentation Hall of Shame

"If the mouse doesn't work under Windows, open the Windows Program Manager and double-click on the Windows Setup icon."—IMSI MOUSE DOCUMENTATION

Available in Limited Quantities:

- Canon Bubbie Jet Word Processor (PRO5000), no rain checks

A printer only a Jewish grandmother could love. (Lachmere ad.)

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, PC Magazine, One Park Ave., New York, NY 10016-5802 or via e-mail (text items only) to *don_willmott@zd.com.* Winners this issue: Pat Garverick, Joel Groden, Dan Jablons, Sang Lee, Michael Manley, Robert Starkey, and Thomas Withey.

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Dimension XPS P166c. Estimated

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Dell's featured computer artist is Steven Lyons

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